

AD-A270 292



ATION PAGE

Form Approved  
OMB No 0704-0198

①

to a maximum of 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering the collection of information, and completing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 1993		3. REPORT TYPE AND DATES COVERED THESIS/DISSERTATION	
4. TITLE AND SUBTITLE The Effect of Activity-Based Costing on Logistics Management				5. FUNDING NUMBERS	
6. AUTHOR(S) Terrance Lynn Pohlen					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AFIT Student Attending: Ohio State University				8. PERFORMING ORGANIZATION REPORT NUMBER AFIT/CI/CIA-93-19D	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) DEPARTMENT OF THE AIR FORCE AFIT/CI 2950 P STREET WRIGHT-PATTERSON AFB OH 45433-7765				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release IAW 190-1 Distribution Unlimited MICHAEL M. BRICKER, SMSgt, USAF Chief Administration				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)					
<p><b>DTIC</b> <b>ELECTE</b> <b>S</b> <b>OCT 05 1993</b> <b>D</b> <b>B</b></p> <p><b>93 10 4 049</b></p> <p><b>93-23217</b></p>					
14. SUBJECT TERMS				15. NUMBER OF PAGES 370	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT		18. SECURITY CLASSIFICATION OF THIS PAGE		19. SECURITY CLASSIFICATION OF ABSTRACT	
				20. LIMITATION OF ABSTRACT	

THE EFFECT OF ACTIVITY-BASED COSTING ON  
LOGISTICS MANAGEMENT

DISSERTATION

Presented in Partial Fulfillment of the Requirements for  
the Degree of Doctor of Philosophy in the Graduate  
School of The Ohio State University

By

Terrance Lynn Pohlen, B.S., M.S., M.A.

\* \* \* \* \*

The Ohio State University

1993

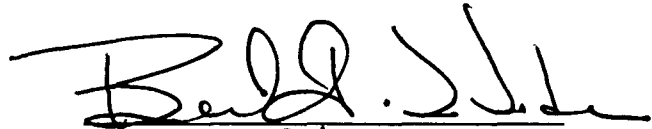
Dissertation Committee:

Dr. Bernard J. LaLonde

Dr. James C. Kinard

Dr. James M. Masters

Approved by

A handwritten signature in dark ink, appearing to read "Bernard J. LaLonde", is written over a horizontal line.

Adviser

Graduate Program in  
Business Administration

Copyright by  
Terrance Lynn Pohlen  
1993

DTIC QUALITY INSPECTED 2

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Avail and/or Special	
A-1	

To Susan



## ACKNOWLEDGMENTS

Many individuals gave freely of their time and shared their knowledge during the research. The recognition and gratitude provided here cannot begin to repay them for their support and friendship.

I would like to thank the eleven organizations participating as case studies. They have asked to remain anonymous; however, they played a key role in expanding the existing knowledge of applying activity-based costing within logistics. I greatly appreciate the time, expertise, and friendship provided by these organizations.

Professor Bernard J. LaLonde, my dissertation chairman and academic advisor, deserves special recognition for introducing me to activity-based costing and for his support during the research. His foresight, criticisms, and direction have proven invaluable throughout my doctoral studies. Professors James C. Kinard and James M. Masters also gave freely of their time and knowledge. Their insight and counsel greatly assisted in the development of the research.

I want to especially thank the United States Air Force and the Air Force Institute of Technology for the opportunity to pursue a doctorate and for the support provided during my assignment to The Ohio State University.

My family deserves my final and deepest expression of gratitude. I want to thank my daughters, Amber and Hilary, for their understanding and support during the research. My wife, Susan, has provided a constant source of encouragement and inspiration. She has my many thanks, and all my love.

## VITA

May 19, 1956..... Born — Fosston, Minnesota

1979..... B.S., Moorhead State  
University, Moorhead,  
Minnesota

1983..... M.S., Air Force Institute of  
Technology, Wright-Patterson  
Air Force Base, Ohio

1992..... M.A., The Ohio State  
University, Columbus, Ohio

## PUBLICATIONS

LaLonde, Bernard J., James M. Masters, and Terrance L. Pohlen, "The 1991 Ohio State University Survey of Career Patterns in Logistics," *Annual Conference Proceedings of the Council of Logistics Management*, Volume 1, Oak Brook, IL: Council of Logistics Management, October 1991, pp. 43-64.

Masters, James M., Bernard J. LaLonde, and Terrance L. Pohlen, "For Logistics, a Subtle Shift in Organization," *Distribution*, Volume 91, January 1992, pp. 48-51.

Masters, James M., Bernard J. LaLonde, and Terrance L. Pohlen, "Logistics Evolution Continues," *Distribution*, Volume 90, November 1991, pp. 38-43.

Pohlen, Terrance L. and Martin T. Farris II, "Reverse Logistics in Plastics Recycling," *International Journal of Physical Distribution and Logistics Management*, Volume 22, Number 7, 1992, pp. 35-47.

## **FIELDS OF STUDY**

**Major Field: Business Administration**

**Studies in Logistics: Professors Bernard J.  
LaLonde, Martha C. Cooper, and  
James M. Masters**

**Second Field: Industrial Systems Engineering**

**Studies in Industrial Systems Engineering:  
Professors Jane M. Fraser, Gordon M.  
Clark, and Charles H. Reilly**

## TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	iii
VITA.....	v
LIST OF TABLES.....	x
LIST OF FIGURES.....	xii
GLOSSARY OF TERMS.....	xv
CHAPTER	PAGE
I. INTRODUCTION.....	1
Activity-Based Costing Background.....	5
Application of Activity-Based Costing to Logistics.....	6
Significance of Activity-Based Costing.....	7
Problem Statement.....	9
Research Objectives.....	11
Scope of the Research.....	15
Research Propositions.....	18
Research Methodology.....	21
Limitations and Assumptions.....	24
Contributions.....	25
Organization of the Research Report.....	31
II. LITERATURE REVIEW	
Introduction.....	32
The Changing Business Environment.....	33
Activity-Based Costing.....	58
Comparison Between Activity-Based Costing and Traditional Cost Systems.....	73
Implementation and Design of Activity-Based Costing Systems.....	99
Cost Accounting Applications Within Logistics.....	116
Activity-Based Costing Applications Within the Supply Chain.....	132
Summary.....	134

### III. METHODOLOGY

Introduction.....	136
Design of the Research.....	140
Validation of Variable Classification.....	146
Research Questions.....	148
Research Propositions.....	148
Implementation of the Research Design.....	161
Phase I Validation and Selection.....	161
Phase II Data Collection.....	165
Phase III Data Analysis.....	168
Summary.....	171

### IV. RESULTS OF THE STUDY..... 172

Introduction.....	172
Findings Relative to the Research	
Propositions.....	173
Other Findings.....	204
Summary.....	217

### V. SUMMARY AND CONCLUSIONS..... 219

Introduction.....	219
Research Summary.....	219
Conclusions.....	222
Conclusions — Research Methodology.....	260
Implications.....	266
Suggestions for Future Research.....	285
Summary.....	290

### APPENDICES

A.	Activity-Based Costing Questionnaire.....	291
B.	Background Questions for Research	
	Criteria Analysis.....	295
C.	Interview Protocol.....	298
D.	Survey Results: ABC Applications	
	Within Logistics.....	313
E.	Extracts from the 1993 Warehousing Education	
	and Research Council and The Ohio State	
	University Survey of Warehousing and	
	Distribution Costs.....	326
F.	Logistics Costing Questionnaire.....	342
G.	Logistics Costing Questionnaire Results.....	346

H. Profile of Researched Organizations.....	363
BIBLIOGRAPHY.....	367

## LIST OF TABLES

TABLE	PAGE
1. Calculating Direct Product Cost Per Case.....	89
2. Definition of "Effect on Logistics Decision-Making and Performance Measurement Variable.....	142
3. Definition of "Size of Organization" Variable..	143
4. Definition of "Classification of Activity-Based Costing Implementation Stages" Variable.....	144
5. Definition of "Organization of Logistics Function" Variable.....	145
6. Research Matrix.....	146
7. Benefits Identified by Large Firms.....	176
8. Benefits Identified by Small Firms.....	177
9. Time Required for Implementation of an Activity-Based Costing System (N=8).....	178
10. Impact of Size and Organization of Logistics on the Complexity and Sophistication of the Activity-Based Costing System.....	180
11. Type of Activity-Based Costing Implementation...	183
12. Impediments Identified by Implementation Stage.....	187
13. Impact of Product and Customer Diversity on the Design of the Activity-Based Costing System.....	189
14. Factors Influencing Increased Contact Between Logistics and Other Functions Within the Firm.....	199



15.	Planned and Actual Uses of Activity-Based Costing for Evaluating Supply Chain Performance.....	201
16.	Justification Reported for Developing an Activity-Based Costing System.....	205
17.	Breakdown of Warehouse Costs 1992 – 1995.....	330
18.	Case Study Participants Individuals Contacted..	366

## LIST OF FIGURES

FIGURE		PAGE
1.	Two Dimensions of Activity-Based Costing.....	62
2.	Conceptual Model of an Activity-Based Costing System.....	63
3.	Illustration of James P. Borden's Cost Assignment Example.....	66
4.	Comparison of Direct Product Profitability (DPP) and Activity-Based Costing (ABC).....	91
5.	Comparison of Traditional Cost Accounting with Activity-Based Cost Accounting.....	98
6.	Optimal Cost System.....	103
7.	Types of Businesses Participating in the Questionnaire.....	315
8.	The Current Status of Activity-Based Costing Within the Surveyed Firms.....	316
9.	Origin of Activity-Based Costing Proposal.....	317
10.	Individual Spearheading Activity-Based Costing Implementation Effort.....	318
11.	Responses to Whether Activity-Based Costing Was Justified on Cost Savings or Avoidance....	319
12.	Benefits Obtained from Activity-Based Costing Implementation.....	319
13.	Problems Encountered During Activity-Based Costing Implementation.....	320
14.	Functions Implementing Activity-Based Costing..	321
15.	Percentage of Respondents Planning to Implement Activity-Based Costing Elsewhere Within Their Firm.....	322

16.	Selected Categories as a Percentage of Total Logistics Costs.....	328
17.	Company Warehousing Cost by Major Category.....	329
18.	Requirement to Break Out Overhead Costs by Product, Customer, Service or Warehousing Activity.....	331
19.	Responses Regarding Requirement to Trace Indirect Costs to Specific Activities.....	332
20.	Percentage of Firms Investigating Activity-Based Costing.....	333
21.	Impact of Competitive Pricing on Overhead Breakout by Service, Product, or Customer....	333
22.	Use of a Single Factor to Determine Warehousing Charges.....	334
23.	Use of Multiple Factors to Determine Warehousing Charges.....	335
24.	Ability to Breakout Warehousing Overhead by Major Activity.....	336
25.	Warehousing Executives' Ability to Trace Resource Costs to Specific Activities.....	337
26.	Ability to Calculate Costs of Specific Activities.....	338
27.	Ability of Warehouse Executives to Break Out Activity Costs by Product, Customer or Mode.....	339
28.	Ability of Performance Measurement System to Track Resources and Activity Volumes.....	340
29.	Integration of Performance and Financial Management Systems.....	341
30.	Responses to Use of a Single Cost Driver.....	354
31.	Use of Multiple Drivers to Determine Charges...	354
32.	Diverse Range of Logistics Service Offerings...	355
33.	Services Consume Unequal Amounts of Support....	355

34.	Overhead Broken Out by Actual Consumption.....	356
35.	Breakout Overhead to the Activity or Task Level.....	356
36.	Determine Amount of Overhead Consumed by Individual Activities.....	357
37.	Competitive Pricing Has Forced a Revision of Logistics Charges.....	357
38.	Cost Accounting System Can Demonstrate a Cause and Effect Relationship.....	358
39.	Can Cost Specific Activities by Product, Customer, or Mode.....	358
40.	Firm Has Obtained a Competitive Advantage Through More Accurate Pricing.....	359
41.	Ability to Translate Improvement Into Cost Savings at Activity Level.....	359
42.	Investigating Use of Activity-Based Costing....	360
43.	Implementing Activity-Based Costing.....	360
44.	Allocation of Overhead Not an Important Element of Costing or Performance Measurement.....	361
45.	Vendor Evaluation Will Be Based on Total Cost Rather Than Price.....	361
46.	Current Cost Accounting System Can Trace Costs to Specific Vendors.....	362
47.	Will Need to Accurately Break Out Costs to Remain Cost Competitive.....	362

## GLOSSARY OF TERMS

**ACTIVITY.** Activities are the business processes that transform inputs into outputs under the constraints set by controls performed by the organization's people and their tools. Activities can also be perceived as consumers of resources in production of materials, services, events, or information [44:102].

**ACTIVITY ANALYSIS.** The identification and description of activities in an organization. Activity analysis involves determining what activities are done within a department, how many people perform the activities, how much time they spend performing the activities, what resources are required to perform the activities, what operational data best reflect the performance of the activities, and what value the activity has for the organization. Activity analysis is accomplished by means of interviews, questionnaires, observation, and review of physical records of work [121:57].

**ACTIVITY-BASED BUDGETING.** Preparation of cost budgets using ABC to help estimate work load and resource requirements [142:315].

**ACTIVITY-BASED COSTING.** A methodology that measures the cost and performance of activities, resources, and cost objects. Resources are assigned to activities, then activities are assigned to cost objects. Activity-based costing recognizes the causal relationship of cost drivers to activities [121:57].

**ACTIVITY-BASED MANAGEMENT.** A discipline that focuses on the management of activities as the route to continuously improving the value received by customers and the profit achieved by providing this value. This discipline includes cost driver analysis, activity analysis, and performance analysis. Activity-based management draws on activity-based costing as a major source of information [142:315].

**ACTIVITY DRIVER.** A factor used to assign cost from an activity to a cost object. A measure of the frequency and intensity of use of an activity by a cost object [142:315].

**AGGREGATION.** The roll-up or combining of smaller activities into a larger activity.

**CAUSALITY.** Causality is defined as the property of the cost driver that, when the level of the driver increases (decreases), the cost pool level increases (decreases) proportionally. Proportionality is a condition which is seldom satisfied due to the presence of lumpy (indivisible) resources [89:3].

**COST ASSIGNMENT.** The tracing or allocation of resources to activities or cost objects [121:58].

**COST DRIVER.** A factor whose occurrence creates cost. The factor represents a prime cause of the level of activity [18:204].

**COST OBJECT.** Any customer, product, service, contract, project or other work unit for which a separate cost measurement is desired [121:59].

**CROSS SUBSIDY.** The improper assignment of costs among cost objects such that certain cost objects are overcosted while other cost objects are undercosted relative to the activity costs assigned. For example, traditional cost accounting systems tend to overcost high-volume products and undercost low-volume products [121:59].

**DIAGNOSTIC ABC SYSTEM.** A diagnostic ABC system is the application of ABC solely for supporting process reengineering or identifying nonvalue-added activities. The diagnostic approach is a one time analysis of a business process, has a clearly defined and limited scope, and is not used for managing or assigning costs on an on-going basis. Diagnostic ABC systems are used to quickly diagnose the activities performed in a process, the costs consumed by the activities or cost objects, and to focus and prioritize subsequent management action.

**DIVERSITY.** Conditions in which cost objects place different demands on activities or activities place different demands on resources [121:59].

**FIXED COSTS.** Costs that do not vary in total with changes in activity level, at least within a relevant range [134:817].

**MACRO ACTIVITY.** An aggregation of related activities. This helps manage detail in an ABC system without reducing the useful information available [142:317].

**NONVALUE-ADDED ACTIVITY.** An activity is defined as nonvalue-added when the costs of the inputs plus activity costs is greater than the worth of the output product or service [44:103].

**RESOURCE DRIVER.** The links between resources and activities. They take cost from the general ledger and assign it to activities [142:318].

**RESOURCES.** Economic elements applied or used in the performance of activities [142:318].

**SUNK COSTS.** Costs that have already been incurred and cannot be changed by current or future decisions [134:827].

## CHAPTER I

### INTRODUCTION

The accounting and control of logistics costs will become increasingly important to firms seeking a competitive advantage in the 1990s. The forces driving the emphasis on improved logistics costing include an extremely competitive global marketplace [33:134], [135:29], contribution of logistics to total product cost [137:568], [149:215-217], and the inability of conventional cost accounting to provide meaningful assessments of logistics costs or performance [81:245-247], [127:1-7].

The business environment has become very competitive with profound implications for cost management systems. Consumers have influenced competitiveness by demanding higher quality, expanded functionality, and lower prices in purchased products or services [18:1]. Customers will continue to seek improvements in quality or price from alternative suppliers. Sellers who can competitively price and deliver their product will gain an advantage with the customer [53:134]. Global competitors have further increased marketplace complexity through increased production flexibility, lower costs, and the use of time as



a source of competitive advantage [135:29]. The resulting implications for cost management systems stem from the demands for more accurate knowledge of product costs, excellent cost control, and coherent performance measurement [81:220]. Cost management plays a critical role in how firms attempt to achieve a competitive advantage, either through cost or differentiation:

Cost advantage is one of the two types of competitive advantage a firm may possess. Cost is also of vital importance to differentiation strategies because a differentiator must maintain cost proximity to competitors. Unless the resulting price premium exceeds the cost of differentiating, a differentiator will fail to achieve superior performance [119:62].

The logistics function offers a particularly effective avenue for obtaining a competitive advantage through cost reduction or service differentiation [149:217]. Estimates of logistics activity costs as a percentage of revenue range as high as 25 to 50 percent [120:13], [149:215] and 25 percent of the cost at the manufacturing level [137:567]. In many firms, logistics offers one of the most promising areas to leverage additional profits [137:26]. The cost savings available within logistics can have a far greater impact on profitability than by attempted to increase sales volume, especially when factors such as competition, market growth rates, and company resources may preclude any significant sales increase [93]. Despite the opportunity for increased profitability, logistics costs have received

limited attention [137:568]. As a result, logisticians frequently lack the necessary cost data or management tools to achieve cost reductions [127:1-1], [151:1], [150:60], [150:56], [120:13].

Conventional cost accounting has not provided managers with the information needed to exploit the competitive advantages available within logistics. Managers do not have the information needed to fully understand the costs of reaching and servicing particular types of buyers or of using alternate distribution channels [81:24-247].

Conventional cost accounting systems fail to analyze or trace logistics costs due to several factors such as: the use of a single activity measure such as direct labor to allocate overhead [81:188-192], periodic versus product treatment of costs [127:1-8], cross-subsidization of costs between products [28:86-88], and differences in the classification and reporting of physical distribution costs [127:1-7]. A definite need exists for an accurate portrayal of logistics costs by product, customer, or channel:

A business unit usually produces a number of different product varieties and sells them to a number of different buyers. It may also employ a number of distribution channels. For example, a shipbuilder constructs both liquid natural gas tankers and container ships while a bank lends to sophisticated high net-worth individuals as well as to middle income customers. Any of these differences may give rise to segments in which the behavior of costs in the value chain may be different. Unless the firm recognizes differences in cost behavior among segments, there is a

significant danger that incorrect or average-cost pricing will provide openings for competitors [81:245].

The supply channel can also provide a source of competitive advantage [120:9]. Organizations can exploit the linkages between channel members to lower total cost through coordination or joint optimization [119:77]. Coordinated channel action in the form of quick response, distribution resource planning, or just-in-time inventories can drive down overhead costs and eliminate paperwork, unnecessary activities, and financial transactions [106:21], [47:9]. Porter suggests that differentiation, another form of competitive advantage, also stems from the supply channel. The channel can enhance the reputation, service, customer training of the firm [106:123]. However, many organizations overlook vertical linkages because of the difficulty in understanding and analyzing supplier and value chains [119:76].

The emphasis on logistics and channel costing stems from intense marketplace competition, the major effect logistics has on product costs, and the inability of conventional cost systems to support a growing requirement for accurate and timely logistics costs by product, customer and distribution channel. These marketplace forces indicate the requirement for a cost accounting system with the ability to isolate and categorize logistics costs as well as

to identify areas for potential improvement and to measure performance.

### Activity-Based Costing Background

Activity-based costing (ABC) is "a methodology that measures the cost and performance of activities, resources, and cost objects. Resources are assigned to activities, then activities are assigned to cost objects based on their use. Activity-based costing recognizes the causal relationships of cost drivers to activities" [121:57].

ABC systems focus on activities, the work performed in an organization [121:57], as the principal means for allocating costs [31:45]. An ABC system follows a two stage allocation procedure to assign costs to activities and subsequently to cost objects — the products or services produced by the organization [34:39]. The first stage assigns costs to the activities [34:40]. Costs flow from the resources to the activities based on the amount of resources consumed in performing the activities [142:97]. The second stage assigns costs to cost objects, the products or services produced, using cost drivers [34:40]. Cost drivers reflect the use of activities in producing a product or service. The total cost of the cost object would equal the sum of the costs of all of the activities required to manufacture and deliver the product or service [31:46].

Turney notes that second generation ABC systems have begun to appear in response to a growing need for supplying operational information about activities [142:80-81]. The second generation ABC systems have evolved beyond a cost assignment view to incorporate a process or performance measurement view. The process view capitalizes on the non-financial data contained in activity volume and consumption to measure performance — what causes work and how well it is done [142:81]. Several authors refer to the coupling of financial and non-financial information in these two-dimensional ABC systems as activity-based management (ABM) [142:315], [24:54], [121:58].

#### Application of ABC to Logistics

Practical applications of ABC have emerged only within the past ten years [29:33], and the focus of these applications has centered on manufacturing process rather than on logistics or other service industries [120:9] [124:4]. However, logistics confronts many of the same conditions which make manufacturing a good candidate for ABC application: diversity of resource consumption; and product and resource consumption not correlated with traditional volume-based allocation measures [124:8].

Logistics may represent one of the most effective areas for applying ABC [101:38]. Logistics accounts for more than 50 percent of the total costs in many product lines and

approximately 20 percent of the U.S. Gross National Product [101:33]. Distribution [logistics] managers can use the information obtained from an ABC system to help reduce costs by decreasing the number of times an activity is performed and by reducing the cost per unit of activity [126:45]. Management can also use ABC to identify the logistics processes impacted by corporate strategies and the costs of those activities and opportunities where new technology could eliminate activities and cost [120:9-14].

#### Significance of Activity-Based Costing

ABC implementation within logistics represents a significant issue for several reasons. First, conversion to an ABC system will significantly alter the reporting of logistics costs. Logistics costs will become more visible and traceable to specific products or services [115:5][125:33]. Businesses implementing ABC must determine the most appropriate technique for accurately costing logistics resources and tracing the costs to individual activities and cost objects. The increased visibility will place greater demands on logistics managers to control and subsequently reduce costs.

Second, ABC implementation will impact logistics decision-making. Logistics managers will have a greater understanding of the activities driving logistics costs [126:45], [120:13], and managers can use the activity-based

information to streamline logistics processes and to eliminate unnecessary activities [120:13]. Internal cost relationships will change as logistics managers attempt to leverage additional profitability through more efficient operating practices and effective cost trade-offs with other functions within the organization [71:219]. Logistics decisions regarding external relationships may also change. ABC will provide logistics managers with the capability to assess the costs of alternative channel structures — changes in the vendor and customer base or warehouse locations and transportation modes [101:34], [120:14], [130:20]. The crossing of functional and company boundaries will also require logistics executives to ". . .adapt to a new style of cooperative management with counterparts up and down the supply chain and across the management hierarchy" [1:274].

Third, external relationships within the supply chain will change. Logistics managers will have the capability to analyze the profitability by customer or supply channel [41:133]. The firm may restructure the channel by adding or dropping suppliers, customers, or products to reduce costs and improve profitability. Managers may also attempt to make cost trade-offs within the channel to reduce their total distribution costs [119:77].

Fourth, the coupling of financial and non-financial information in ABC may transform the standards used to measure logistics performance. Firms can link the costs of

performing organizational activities to specific products and customers [37:1] and evaluate management decisions based on their ability to increase profitability. Managers can increase profitability by decreasing the demand for support resources, by reducing the number of times activities are performed, or increasing the efficiency with which activities are performed [37:10]. Firms may subsequently hold logistics managers to a higher level of cost accountability due to increased visibility of logistics costs and the ability to trace management action to costs at the product or service level.

#### Problem Statement

The number of firms implementing activity-based costing has substantially increased during the past few years, and a trend towards implementing ABC appears to have begun. ABC initially focused on the manufacturing environment where direct labor cost has dwindled to a very small percentage of total product cost, and management has realized the need for more accurate ways of assigning overhead to product costs [23:15]. However, ABC also appears well suited for expansion into logistics and some other service activities [126:42], [23:15], [124:14]. Manufacturing experience suggests that ABC implementation in logistics will have a major effect on the costing, performance measurement, and inter- and intra-firm relationships of logistics functions.



However, the magnitude of these expected changes remains unknown. As a result, firms expanding or implementing an ABC system for logistics have limited prior knowledge regarding the availability of cost data, implementation problems, coordination requirements, costing methodologies, techniques for measuring performance, changes in determining or assigning logistics costs, behavioral responses to cost or performance measurement systems, and the resulting profitability of customers, products, or supply channels.

The logic behind ABC systems has also come under recent criticism. Opponents have challenged ABC on its underlying assumption of activities causing cost [117:37], [118:47]. Fixed overhead allocations used in many ABC systems have generated debate regarding the difference between "theory and practice" and the relevance of considering fixed or "sunk" costs in decision-making [61:32] [102:37].

The impediments confronting the application of ABC to logistics include:

(1) ABC implementation will usually have a significant impact on logistics costing; however the extent of the impact on the logistics organization remains unknown.

(2) The shift from a conventional to an activity-based accounting system will substantially alter the reporting and visibility of logistics costs; however, no logistics-wide standards exist for determining resource categories and activities, assigning resource costs to specific activities,

determining whether to assign fixed and "sunk" costs to cost objects, or using ABC information in financial reports.

(3) The use of ABC information is expected to drive significant changes in logistics decision-making and the relationships and behavior between inter- and intra-firm organizations; however, no guidelines exist for managing this change, performing cost trade-offs across multiple boundaries between firms, and allocating costs and benefits between several businesses.

(4) Organizations may perceive ABC implementation as too difficult, expensive, and time consuming [142:215] [140:18]. Changing an existing cost system to an activity-based cost system may involve a significant expense in the form of new computer capabilities [140:18] or other costs. ABC also requires additional data requirements about products or services consumption of activity resources [142:214]. However, Cooper estimates a average implementation will require less than \$100,000 with three people working full-time for between four and six months [29:33].

#### Research Objectives

The research had the objectives of ascertaining whether ABC has effected logistics decision-making and performance measurement, examining how ABC has changed the reporting and allocation of logistics costs, determining how ABC has

affected relationships between logistics and other functions internal to the firm, determining how ABC has modified relationships between logistics and other firms in the supply chain, examining how logistics organizations designed and implemented ABC, describing how logistics organizations have overcome any impediments encountered during implementation, and identifying opportunities for future research.

The research used descriptive and prescriptive approaches for examining the effect of ABC on logistics. The descriptive approach recorded and presented the results organizations obtained or expected to obtain from implementing ABC. The prescriptive approach developed conclusions from the research to suggest how logistics organizations should design an ABC system, recommended techniques for implementation and overcoming impediments, and identified where ABC information could improve performance measurement and the costing of logistics.

The specific research questions addressed in this research include:

1. Why did firms participating in the research consider implementing an ABC system within the logistics function by designing or expanding an existing ABC system for logistics from elsewhere in the firm?
  - a. What problems have the logistics functions encountered with their current cost accounting systems?

- b. What benefits the logistics organizations can from expect an ABC system?
- c. What criteria did the logistics organizations use to evaluate the feasibility of an ABC system?

2. How should logistics organizations design an ABC system and plan and manage the ABC implementation process?

- a. What decision-making process did the firms follow in obtaining approval for implementing ABC?
- b. What design elements did the organizations consider, and how did the design affect implementation?
- c. What steps did the participating firms follow during implementation?
- d. Do logistics organization share a common profile of the change process? Do the organizations employ similar ABC designs and implementation methodologies? Have they incurred similar time and resource requirements?
- e. What impediments did the firms encounter, how did they overcome the obstacles, and which obstacles originated within the logistics functions?

3. How does a transition from a conventional to an activity-based cost accounting system change the reporting of logistics costs?

- a. Do the participating firms assign fixed or sunk costs to the cost object?
- b. How did the reporting of logistics costs change in dollar value and in management reports?
- c. What resources, activities, and cost drivers did the participating firms use and why did they select them?

- d. Have the participating firms used ABC data in their financial reports?
4. How did information obtained from an activity-based cost system effect logistics decision-making?
- a. What management actions directly resulted from ABC implementation?
  - b. Did the firms alter their performance measurement systems to incorporate data obtained by ABC, and did ABC implementation provide any additional insight into the logistics processes?
  - c. How did the participating firms use the non-financial information available within ABC to measure logistics performance?
5. How has ABC altered the relationship of the logistics functions to other businesses activities within and outside the boundaries of the participating organizations?
- a. How has ABC changed cost reporting and performance measurements spanning intra-firm boundaries?
  - b. Did the use of ABC information alter any of the logistics cost trade-offs previously used within the participating firms? Have the firms used the information to perform cost trade-offs with other supply chain members?
  - c. How have the participating firms allocated costs and benefits resulting from cost trade-offs occurring within the firm or across multiple firm boundaries?
  - d. How have the participating firms used ABC to influence behavior within and outside their boundaries?
  - e. Have the firms used ABC to determine and manage total product or service costs?

- f. What impediments confront the application of ABC information across a supply chain?

### Scope of the Research

The research focused on ABC implementation and use within logistics. The functional alignment of logistics activities may vary across firms; however, the study examined how firms have initially implemented an ABC system and subsequently used ABC to trace and assign logistics costs throughout an organization. Logistics functions and costs play an important role in non-manufacturing and government organizations. The participating firms in the study included government organizations possessing logistics functions.

ABC has enjoyed extensive application within the manufacturing functions of many of the participating firms; however, the study was limited to an examination of logistics functions. ABC applications in manufacturing or production industries have been well documented by authors such as Cooper, Kaplan, Brimson, and Turney. ABC applications within the service industry, and particularly logistics, have not undergone an extensive examination. Rotch suggests ABC may prove useful to the service industry, but implementation within service activities face special challenges not encountered in manufacturing [124:4-14]. Despite the challenges, logistics appears ideally suited for ABC applications [120:13] [101:34].

While the general subject area of this study is the use of cost accounting information in logistics decision-making, the study was limited to examining how implementation of an ABC system effects logistics decision-making and performance measurement. The study examined the differences between the use of conventional cost accounting and ABC system information in logistics; however, the research concentrated on examining how activity-based cost information has affected management decisions regarding logistics activities internally within the organization and vertically in the supply channel.

The research analyzed the effect of ABC on logistics management by using four independent variables. The rationale for the variables is included in Chapter Three. The four variables included: (1) size of the organization, (2) stage of ABC implementation, (3) centralization of the logistics function, and (4) effect of implementing ABC on logistics decision-making and performance measurement. Tables 2, 3, 4, and 5 located in Chapter Three define the research variables and the variable categories. The following paragraphs provide a summary of the "variable" definitions.

The "size of the firm" variable divided the case study organizations into small and large categories. Small organizations had gross sales of less than one billion

dollars, and large organizations had gross sales exceeding one billion dollars.

The variable of "stage of ABC implementation" was defined as the status of ABC planning and operation at the time of interviewing a participating firm. The variable had five levels: problem definition, planning, data collection, design, and operational.

The third variable "centralization of the logistics function" was defined by the level within the firm exercising logistics planning, control, and cost management. The research divided the organizations into two categories, centralized or decentralized.

The fourth variable "effect of implementing ABC on logistics decision-making and performance measurement" was defined to include changes in logistics cost trade-offs, changes in the assignment of logistics overhead costs to the cost object, implementation of activity-based performance measures, and changes to internal and external relationships as identified during the interviews and site visits.

The research applied a case study approach to examine a limited subset of logistics organizations. The objective of the research concentrated on developing a depth of knowledge regarding the logistics practices of a limited number of leading-edge firms. As a result, the study did not include an extensive survey, such as mailing questionnaires, to examine the research variables.



### Research Propositions

The research examined several propositions regarding ABC applications within logistics. The propositions identified the specific properties and relationships analyzed by the research. The research incorporated propositions to accommodate an exploratory and in-depth examination of a limited number of business and government organizations. The limited number of organizations precluded statistical testing, and the research employed qualitative analysis to examine the propositions. Examination of the research propositions determined the direction and magnitude of the studied properties and relationships. Therefore, the propositions appeared in the null case during the research. The rationale for the propositions is included in Chapter Three.

#### Size of the Organization:

##### Proposition A1.

The size of the firm and organization of logistics will have no impact on the number and types of benefits reported by logistics personnel.

##### Proposition A2.

The size of the firm will have no affect on the length of time required to implement an ABC system.

Organization of the Logistics Function:

## Proposition B1.

The size of the firm and the centralization of logistics management will have no affect on the complexity, measured in cost drivers and activities, and the sophistication, determined by size and frequency of cost and activity updates, of the ABC system.

## Proposition B2.

Centralization of logistics management will have no affect on whether the firm adopts ABC as a cost management system or uses ABC as a diagnostic tool.

Implementation Stages:

## Proposition C1.

The methodology employed for implementing ABC will not vary by the size of the firm.

## Proposition C2.

The number of major impediments, measured in number and type, will not differ by implementation stage.

## Proposition C3.

Customer and product diversity will have no impact on the complexity and design of the ABC system.

Logistics Decision-Making and Performance Measurement

Proposition D1.

ABC implementation will not influence logistics managers' perceptions of their ability to effect changes in the total cost of the cost object.

Proposition D2.

ABC implementation will have no impact on the performance measurement system for logistics by tracing management action to changes in the total cost of the cost object.

Proposition D3.

ABC information will have no affect on how the researched organizations select and evaluate other members within the supply chain.

Proposition D4.

ABC information will have no affect on the number of contacts, measured in volume between logistics functions and other functions within the firm.

Proposition D5.

ABC information will not change the performance evaluation by the researched organizations for other organizations in the supply chain.

Proposition D6.

ABC implementation will have no affect on the amount of logistics overhead assigned to the cost object – brand, product, customer, or supply chain.

### Research Methodology

The research performed in-depth case studies of selected firms which have considered or implemented an activity-based cost system. The study identified and selected logistics organizations in government and business. The selected firms represented several of the ABC implementation stages. Field studies within these firms consisted of in-depth personal interviews of individuals involved in the ABC decision making and implementation processes.

The research implemented a two by two research design as shown in Table 6 found in Chapter Three. The variables "centralization of logistics" and "size" divided the design into a matrix with four cells. The research used purposive selection of organizations in each of the matrix cells.

The exploratory nature of the research and limited number of firms precluded the use of quantitative analyses. Instead, the methodology employed a qualitative research approach developed by Glaser and Strauss and developed grounded theory regarding the implementation, use, and impact of ABC on logistics relationships:

A grounded theory is one that is inductively derived from the study of phenomenon it represents. That is, it is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon. Therefore, data collection, analysis, and theory stand in reciprocal relationship with each other. One does not begin with a theory, then prove it. Rather, one begins with an area of study and what is relevant to that area is allowed to emerge [138:23].

Grounded theory meets the criteria for scientific methodology: significance, theory-observation compatibility, generalizability, reproducibility, precision, rigor, and verification [138:24].

The methodology employed in the research consisted of (1) data collection through personal interviews, on-site visits, supplemental materials, and a review of technical literature; (2) coding of the data to organize the data for analysis, putting the data back together in new ways by making connections between categories, and selecting the core or main category and systematically relating it to other categories, and validating those relationships; (3) developing process relationships to link sequences of events; and (4) development of a framework that summarizes and integrates the data.

Organizations selected for the study included those recommended by knowledgeable individuals in the logistics industry, those detected during the literature review, and those responding to an initial questionnaire sent to large

corporations possessing a vice-president position, or equivalent, for logistics or distribution.

The research used personal interviews from eleven participating organizations. Individuals participating in the interviews received a copy of the interview protocol contained in Appendix C prior to the interviews. Prior review of the interview guide permitted the respondents to thoroughly consider the discussion topics and how they related to their practice. The interview guide served as a framework to guide questioning and discussion during the personal interviews.

On-site visits, materials obtained from participating firms, and a review of logistics cost reports supplemented the personal interviews. The research utilized ABC proposals, milestone reports, implementation guidelines, operating procedures, activity analyses or flowcharts when available or appropriate.

Results obtained from the interviews were used to develop a summary of the implementation and subsequent decision-making actions taken by the participating organizations. The summaries were used to reach conclusions regarding the propositions and to develop some general guidelines for implementing ABC within logistics.

### Limitations and Assumptions of the Research

The research focused on the use of activity-based costing within logistics and studied the approach in depth. Limiting the range of the study to the implementation of ABC in logistics enabled the research to achieve sufficient density and depth and to achieve potentially reproducible results.

First, the study evaluated only the changes involving the implementation of an activity-based costing system within logistics. Although the results had applications for ABC implementation in other portions of the firm, the study specifically limited the focus the effect of ABC on the costing of logistics functions and relationships.

Second, the study constrained the measuring the effect of ABC on logistics relationships to the physical process, organization of activities, and changes in intra- and inter-firm relationships.

Third, the exploratory nature of research and the necessity to study each organization in depth limited the number of organizations in the study. The limitation permitted a more detailed analysis of the approaches of individual organizations and their use of ABC systems. The organizations participating in the research represented a cross-section of the logistics organizations and possess characteristics similar to other organizations considering ABC implementation; however, the reader should exercise

caution in applying these findings due to the limited number of organizations studied differences existing in other industries and individual organizations.

The research made three assumptions regarding data collection, analysis, and conclusions. First, the research assumed the participating organizations reflected leading practice within the logistics field. Second, the selection process assumed the organizations possessed sensitivity to changes in the business environment and the requirement for more accurate cost data. Third, the research assumed the individuals contacted during the interview process had a thorough knowledge and could provide accurate information regarding ABC implementation within their organization. The interviews included individuals actively involved in the ABC implementation or approval process.

#### Contributions of the Research

Logisticians have continually identified the accounting and control of logistics costs as a major issue. Van Creveld indicated that logistics costs posed a major issue as early as the mid-1500s during the Thirty Years War [153:9]. Heckert identified the increased importance of distribution costs as a business factor in the early 1940s [69:5]. The Council of Logistics Management commissioned several studies in the 1970s and 1980s examining various aspects of logistics cost and control [55], [56], [127].



Annual surveys conducted by The Ohio State University have detected a similar trend. Logistics managers responding to the Career Patterns survey have consistently identified financial management as an area for future study [93:16] [94:58] and logistics costs as a factor affecting the growth and development of the logistics function in the 1990s [94:60].

The results of the research contributed to logistics practice by exploring how ABC has affected logistics management at the macro and micro levels and by examining leading-edge implementations within logistics. The macro level contributions included a study of how ABC has affected relationships within the supply chain or provided a competitive advantage for the researched firms. The micro level contributions to logistics practice included managerial understanding of ABC and its implications for logistics, the effect of ABC on the logistics costing and reporting, and the use of activity-based performance measurement. The case studies provided the direction taken by the leading-edge firms, the benefits achieved, and the lessons learned from the implementation experiences of these firms.

### Macro Level Contributions

The research contributed to logistics practice at the macro level by examining the effect of ABC on the internal and external relationships of the logistics function and whether ABC has produced a sustainable competitive advantage.

The study contributed to logistics practice by suggesting how the use of logistics cost data may affect relationships between logistics and other organizations within the firm and those lying outside the boundaries of the firm. The research examined how ABC changed the amount of internal coordination and communication within the organization, the role logistics costs played in management decision-making, and the cost trade-offs occurring between logistics and other activities in the organization. The research also studied how ABC implementation altered the relationships occurring between organizations within the supply chain. The areas examined included the communications occurring between organizations, the exchange of activity-based cost information, and cost trade-offs occurring in the supply chain.

The study contributed to logistics practice at the macro level by also examining whether ABC implementation yielded a sustainable competitive advantage.

Shank and Govindarajan proposed that "Building a sustainable advantage requires a knowledge of the full, linked set of value activities of which the firm and its competitors are a part" [129:20]. The research expands value, or supply, chain theory by analyzing how the analysis of cost drivers and activities across a supply chain affects inter-organizational relationships. The research will identify the types of information exchanged, how supply chain members use ABC information to assess other organizations' performance, and how the organizations attempted to create a competitive advantage.

#### Micro Level Contributions

The research contributed to logistics practice by increasing logistics managers' understanding of ABC, determining the effect of ABC on the reporting and costing of logistics, and how ABC implementation may alter performance measurement within logistics.

Logistics managers will gain a greater understanding of ABC as a result of the research. The literature review has summarized key ABC concepts, provided a comparison of ABC with conventional cost accounting, and outlined the design and implementation issues encountered in manufacturing applications of ABC. The research further promotes their understanding by focusing on the implications of ABC for logistics. The research determined how ABC may impact the logistics manager's cost information, decision-making and performance measurements, and relationships with other functions — internal and external to the organization.

Logistics practice will benefit from the examination of the effect of ABC on the reporting and costing of logistics functions. The research examined whether the tracing of logistics costs to the cost object has increased management visibility over logistics costs or altered the reporting of logistics costs in the financial reports of the organization.

The research determined whether the organizations have incorporated ABC information into their performance measurement systems. The incorporation of cost information into the performance measurement system may affect how logistics managers perceive their ability to influence total product cost. It may also affect their relationships with other organizations. ABC may affect the logistics manager's capability to make cost trade-offs across functional boundaries or across organizational boundaries within the supply chain.

#### Contributions Resulting from Examining Leading-Edge Practice

The study contributed to logistics practice by examining and describing the state-of-the-art implementation of ABC within logistics. The research describes the direction taken by leading-edge logistics firms, the "lessons learned" in the form of implementation guidelines developed from their implementation experience, and the future direction for ABC within logistics.

The results of the research indicate the direction taken by the leading-edge firms in their implementation of ABC. Areas examined included whether the firms replaced their previous cost system with ABC, the role ABC played in the assignment of overhead costs, and the use of activity-based data in their performance measurement systems.

The study identified the benefits obtained by the examined firms. The results suggest ABC implementation within logistics provided many of the same benefits previously obtained in a manufacturing environment. However, ABC applications within logistics may produce even greater benefits due to the large proportion of logistics costs compared to total product cost and the large amount of customer, product, and service diversity present within logistics.

The research also contributed to logistics practice by developing several guidelines for implementing ABC within logistics organizations. The guidelines provide a descriptive analysis of how other firms have implemented ABC and a prescriptive approach for handling unresolved issues and concerns expressed by firms already using ABC systems.

### Organization of the Research Report

Chapter One is an introduction to the research topic and an overview of the study effort. Chapter Two contains the literature applicable to the research. The research design and methodology is included in Chapter Three. The research analysis and results are contained in Chapter Four. Chapter Five includes a summary of the research and the conclusions resulting from the research effort.

## CHAPTER II

### LITERATURE REVIEW

#### Introduction

Chapter One provided the problem statement, research objectives, propositions, and an overview of the study's methodology. A conceptual foundation for the research is provided in this chapter by the reviewing activity-based costing (ABC) literature. Section One is a discussion of the implications for traditional cost accounting systems resulting from a transformation in the business environment during the 1980s. ABC is defined and the costing and process dimensions of an ABC system is reviewed in Section Two. Section Three is a review of how ABC differs from traditional cost accounting, the implications for product costing and management-decision making, and recent criticisms of ABC. ABC design issues and a review of the implementation process is addressed in Section Four.

A more specific discussion of ABC applications and issues within logistics and supply chain management are included in Sections Five and Six. The relationship between traditional cost accounting and logistics, a summary of previous cost accounting research in logistics conducted by

the National Association of Accountants and the National Council of Physical Distribution Management, and description of ABC applications within logistics are included in Section Five. ABC applications and their impact within supply chain management are discussed in Section Six.

### Section One

#### The Changing Business Environment

Brimson regards the 1980s as a time of transition for cost accounting — a prelude to new accounting approaches [18:43-44]. The first section is a discussion of how changes in the competitive and manufacturing environment have affected cost behavior and requirements for cost information. The changes occurring during the 1980s significantly altered a firm's operations and have major implications for their cost accounting systems. The section is concluded by discussing when a firm should consider changing its cost accounting system and what objectives a new cost system should seek to achieve.

The business environment experienced a significant transformation during the 1980s. Intense global competition forced many U.S. companies to make a renewed commitment to manufacturing excellence and to exploit new process technologies, inventory and materials handling systems, and computer-based engineering and design [86:95]. Deregulation, especially in the transportation industry,



opened new opportunities for firms to compete by reducing logistics costs, increasing operating efficiency, and improving customer service [151:4] [81:220]. The changes in the business environment signaled the need for a similar transformation in U.S. firms' cost management systems and practices. Traditional cost management systems presented a distorted view of the firms' operations and did not provide the visibility necessary for encouraging continuous improvement or total quality [18:27]. The shortcomings of some cost accounting systems became pronounced as "a direct result of companies' trying to manage 1990s manufacturing enterprises with a 1920s accounting system" [18:43].

The far more competitive environment in the 1980s has profound implications for cost management systems. Accurate knowledge of product costs, excellent cost control, and coherent performance measurement are more important than they have been in the past [81:220].

#### Implications for Cost Accounting Systems

The key transformation areas with implications for cost management systems include an increased emphasis on the accounting and control of logistics costs, the implementation of advanced manufacturing technologies, total quality management, and continuous replenishment inventory systems. The cost management systems developed in the early 1900s cannot capture the changes in cost behavior and performance occurring in these areas and require modification [86:101], [81:221], [19:27-29]. The following

paragraphs review the implications for cost accounting systems resulting from each of these changes in the business environment.

### Accounting and Control of Logistics Costs

The growth in the importance of the logistics function may drive significant changes in a firm's cost accounting system. Physical distribution cost estimates range from 7.93 to 30 percent of gross revenue [47:359] [120:13], and the management of logistics costs has become increasingly important due to their significant impact on product profitability, product pricing, customer profitability, and ultimately, overall corporate profitability [120:13]. Logistics can offer a key source of competitive advantage through service differentiation or by reducing costs and increasing corporate profitability [149:215]. Despite the magnitude and importance of logistics costs, accountants have not pursued the development of the quantitative data necessary for improving logistics cost analysis [101:34]. Two studies performed by Ernst & Whinney for the NCPDM and the NAA support this position. The studies found firms had increasingly tasked logistics managers to plan and manage complex operations and networks while reducing cost and enhancing service; however, available cost and financial information was often inadequate [151:1]. The cost accounting systems implications resulting from this

situation include the requirement for more accurate costing of logistics functions and the development of cost data to support an integrated logistics management approach.

Firms will require more accurate and detailed logistics cost information from their cost accounting systems [150:56]. Logistics managers require detailed information to make accurate cost trade-offs, determine whether prices adequately recover costs, and to cost alternative options in providing logistics support [150:56]. The increased visibility of logistics costs serves several purposes to the firm: the identification of more direct costs, a better understanding of price/volume relationships, the opportunity to address significant cost reduction opportunities, better evaluation and justification of investments in new technologies, and focusing more attention on these costs [115:7]. Logistics cost will become more important in product pricing decisions as firms seek to reduce costs and attain a competitive advantage [101:33-38].

The requirement for more accurate information will drive several changes in the cost accounting system. Tyndal argues for a more sophisticated cost allocation system to accurately reflect how costs are incurred and to perform profitability analyses of customers [150:60]. However, accurate logistics cost data does not usually exist in a readily accessible or usable form [127:1-1]. Many logistics costs are hidden in vendor invoices and then

buried in other cost centers such as manufacturing or marketing [127:1-1] [137:575]. As a result, the cost accounting system may need to consider a reclassification of logistics costs along organizational lines [127:3-1]. Schiff contended "The late development of the P.D. [physical distribution] concept, accompanied by an identification of the uniqueness of the P.D. function, may be the reason for the failure to generally assemble P.D. costs into a single functional classification" [127:3-1].

Stock and Lambert found the same problem continued to exist 17 years later, and "The challenge is not so much to create new data, since much of it already exists in one form or another, but to tailor existing data in the accounting system to meet the needs of the logistics function" [137:576]. However, cost systems frequently do not capture some logistics costs such as material handling due to the difficulty in tracking and reporting logistics activities [115:7].

Quillian suggests cost accounting can increase the visibility of logistics costs through a three-phase approach [120:10]: (1) conduct a process value analysis of key processes; (2) develop costs for key activities required by the customer; and (3) develop precise costs associated with logistics processes and develop an on-going cost management system to monitor process costs.

Cost accounting must make several adaptations to support integrated logistics management within the firm and across the supply chain. Integrated logistics management refers to the administering of the various activities within logistics as an integrated system with the objective of minimizing total cost while achieving a desired customer service level [137:39-40]. The evaluation of possible cost trade-offs within logistics requires the identification, measurement, and comparison of several key factors. Tyndal identifies the following necessary factors [149:211]:

- Identifying cost drivers, or the structural determinants of the company's logistics activities, and their behavior.
- Measuring cost drivers in sufficient detail so as to understand cause and effect activities.
- Measuring the interaction of cost drivers (e.g., determining whether they reinforce or counteract each other)
- Identifying the specific service levels that matter to customers and measuring their value.
- Recognizing the correct trade-offs among the logistics and service criteria.
- Evaluating these, both as a whole and incrementally, to contain costs without undermining needed differentiation in the distribution function.

The information obtained from integrated logistics management supports many key logistics decisions such as determining needs for warehouse space, identifying warehouse locations, choosing between public or private warehouse ownership, and implementing automation [151:15]. Despite

the major impact and costs involved in these decisions, the information needed to make these decisions remains largely inaccessible. Lambert and Mentzer found in a survey of 300 North American firms that "...the individual cost components necessary to implement logistics cost trade-off analysis, such as inventory carrying costs, transportation cost by channel, product or customer, order processing costs, warehousing costs, and production lot quantity costs, were largely unavailable" [96]. The literature suggests that the integrated logistics management approach will require not only more accurate costing of logistics functions but also the integration of available cost data and the ability to perform total cost analyses both within logistics and across all major processes, such as production and marketing, so as to be able to minimize total cost to the firm.

The development of the supply chain concept poses a more recent and even more significant implication for the cost accounting system. Porter argues that a firm must look beyond its internal actions to reduce costs and explore the linkages between suppliers' value chains and a firm's value chain to identify opportunities for enhancing a competitive advantage [119:51]. Shank and Govindarajan advance Porter's value chain concept and provide a framework for analyzing where in the chain "...costs can be lowered or customer value enhanced" [130:6]. Tyndal provides two similar premises: "The logistics system must be viewed as a

complete system, from the sourcing of raw materials to delivery of products to customers. Each component of the logistics system is linked with, and influences, the operations of the other components" [149:215]. Traditional costing systems have typically ignored costs outside the factory in product costing, but "A good product system will accumulate costs, by product and product line, across the entire value chain so that the company will know its total cost of producing each good and service" [81:244-247].

The literature offers several techniques for cost accounting to support supply or value chain analysis. Herr recommends integrating the base information that threads through the supply chain [71:222]. Houlihan indicates that the horizontal integration of supply chain information would require [74:36]:

- Management of data capture and flow across the functional boundaries without delay and distortion;
- Linking systems for purchasing, production and inventory control, distribution, customer order entry and service;
- Shared ownership of information and a high degree of visibility across all functions of plans, allocations, inventories and customers—as well as replenishment orders.

Tyndal suggests that a costing methodology for analyzing costs and value in the product distribution chain must deal effectively with the following elements of distribution [146:47]:

- The functions that each party performs in the distribution chain.
- The principles that guide operations and operating practices.
- The implications these operating practices have for resource effectiveness trade-offs within each party's operation and among parties in the channel.
- The resources devoted to each of the operations (e.g., personnel, equipment, facilities, capital, and computer systems).
- The units or levels of resource consumption.

The management of supply chain costs will also require the capability to evaluate the value of alternative channel structures [130:20-21] [146:51] [142:107-108] [71:220]. Supply chain analysis will require a cost trade-off capability within the channel to determine the most cost effective allocation of resources [146:47] or to exploit linkages within the channel by eliminating redundant activities [130:20-21]. Channel members will also require the ability to assess the profitability of individual customers and suppliers. Customer costing necessitates identifying and determining all of the costs involved with supporting and maintaining a customer [142:107] [71:220]. Supplier evaluations will require an analysis of the "total cost-of-ownership" to ascertain the effect of individual suppliers on costs throughout the firm's internal processes and downstream supply chain members [63:11].

The cost accounting system must overcome several impediments to support a supply chain analysis. The system must confront several thorny problems such as calculating



the value for intermediate products, isolating cost drivers, identifying linkages across activities, and computing supplier and channel margins [130:13-14].

### Logistics Summary

Logistics costs have a significant impact on an organization's profitability and pricing decisions [120:13]; however, the accounting and control of logistics costs has remained largely ignored by traditional cost systems [101:34-38]. Seeking a competitive advantage through logistics will require several changes in an organization's accounting system. The firms will require a more sophisticated cost allocation system [150:60]. Cost reporting may change to reflect the uniqueness of the logistics function [127:3-1]. The cost system must also provide visibility into the factors driving logistics costs at the process level [120:10].

### Advanced Manufacturing Technology Implementation

The implementation of advanced manufacturing technologies (AMTs) within many U.S. firms has significantly altered cost behavior and highlighted the inability of traditional cost accounting systems to accurately portray product cost [15:5] [19:27-29]. The effects of AMT implementation have become especially important and far reaching as many U.S. businesses have turned to AMTs to

become world-class manufacturers and remain competitive in a global marketplace [75:42]. The implications resulting from AMT implementation include a larger proportion of fixed costs, a shrinking direct labor allocation base and a corresponding growth in indirect costs, and a greater diversity of products or services [19:26-29] [75:44].

The adoption of AMTs within a firm shifts the cost structure toward a greater percentage of fixed costs as investments in state-of-the-art facilities or equipment occur [15:7] [19:27-28]. A fixed cost is defined as a cost that "does not vary with production volume in the short run" [18:111].

The major implication of fixed costs for firms using a traditional cost accounting system results from the accountant's tendency to view fixed costs as "sunk costs" and to consider them as uncontrollable in the short run [18:116]. "Sunk costs are costs resulting from past decisions or commitments and...therefore irrelevant to the consideration of alternative courses of action" [73]. Brimson suggests that accountants tend to treat fixed costs as sunk costs for decision-making purposes:

An activity's cost behavior has traditionally been an important factor in decision making. Proponents of classical contribution analysis hold that separating fixed cost from variable cost is important because a business decision that leads to the recovery of all variable costs and at least a portion of the fixed costs improves the company's financial position.

Fixed costs are considered sunk costs. The argument is that nothing can be done to influence sunk costs, so they are irrelevant to future decisions. The concept of whether to exclude sunk, long-term influenceable costs, from short-term decisions has been the subject of great controversy over the years. One problem associated with sunk cost is that there is no single, consistently used definition for the term [18:115].

As a result, accountants are reluctant to trace fixed costs or allocate them to specific products because they do not view sunk costs as short term controllable or affecting short term decisions [18:114], and fixed costs cannot be traced to specific product areas with the same precision as used to develop traditional financial statements [5:144]. Brimson identified several shortcomings of this view of fixed costs:

There are several fallacies involved in the use of contribution analysis for routine decisions. First, a consequence of contribution analysis is that the company's portfolio of products is a mixture of profitable products that subsidize the fixed costs of other products. The resulting cross-subsidization increases the vulnerability of a company to competitive pressures. Other companies are most likely to compete for the most profitable products since their products are not burdened by subsidizing the fixed costs of other products.

A second impact of selling a product that does not cover all traceable costs is that it sets a market expectation. Once a customer becomes accustomed to a certain price, it is more difficult to raise than to lower prices [18:117].

Luther made a similar argument in his discussion of using sunk costs in decision-making. He contended sunk costs become relevant since they provide a good approximation of the costs a potential competitor would incur to enter the market. The firm should use a product's full costs—including the sunk costs—to set prices without inviting competitors to contest a market niche [102:37].

AMT implementation exacerbates the problems encountered with using direct labor as an overhead allocation basis. Grady identified four commonly encountered problems with using direct labor as an allocation basis [64:11-12]: rapidly changing technology increases support costs and depreciation expenses while decreasing direct labor; little correlation exists between general price increases and the cost of direct labor; automation eliminates direct labor but does not ensure a corresponding reduction in overhead expenses; and, using direct labor as an overhead allocation basis will result in labor intensive products receiving a disproportionate share of overhead. AMT implementation magnifies these problems by reducing the volume of the allocation bases and increasing overhead costs.

A study performed by Miller and Vollman [108] demonstrated how AMT implementation can impact the allocation basis and distort product costs. Automation of the manufacturing function decreases the allocation basis by reducing the amount of direct labor. It is no longer

uncommon to find manufacturing processes where direct labor accounts for only 8 to 12% of the total cost [19:25]. Automation also frequently increases a firm's overhead costs by its inherent capital intensity [19:27]. As a result, the firm's burden rates [the ratios of overhead costs to direct labor costs] experience substantial increases. In some instances, the burden rates increased from a range of 100 to 200 percent to over 1000 percent. Managers at the plants could not understand or explain the meaning of such large burden rates [108:142].

The diversity of products or services made possible by AMT implementation compounds the problems of using a volume allocation basis such as direct labor. Traditional cost accounting systems assume a direct correlation between the level of the allocation basis and the input cost consumed by the product or service. However, as Cooper points out, the amount of overhead resources consumed varies widely by product. Many resources such as setup hours, material handling hours, part orders, market development, promotion and advertising, distribution, and sales do not have equal costs for all products. The activity costs do not necessarily vary with product volume but may vary by product type or the services performed [31:46-48] [75:45]. The volume allocation basis inaccurately costs products by cross-subsidizing overhead costs [18:39] — labor intensive products with little or no overhead requirements will

subsidize other products having little or no direct labor requirements but with high overhead resource consumption. AMT implementation frequently induces this situation. New product lines require less direct labor than more established products, but they consume a disproportionately larger share of overhead resources such as equipment, engineering, and software [144:64-66]. Inaccurate product costs can become an extremely important issue as Turney suggests:

Inaccurate product costs make it difficult to correctly chose which products to sell, how to properly price those products, and how to design them for low cost.

#### AMT Summary

Advanced manufacturing technology adoption has significantly reduced the ability of traditional cost systems to accurately determine product costs [15:5] [19:27-29]. Traditional cost models have relied on direct labor or other unit cost drivers to predict how volume changes would impact resource consumption [64:11-12]. However, AMT implementation has significantly reduced the ability of traditional cost models to accurately determine product costs by significantly decreasing direct labor or material costs, producing higher fixed costs, and increasing product diversity [18:31-39] [31:53].

### Total Quality Management

Total quality management (TQM) has emerged as a source of competitive advantage within many U.S. firms [81:212], and the drive to achieve TQM has significant implications for the cost accounting systems of these organizations. TQM is defined as a management strategy in which all business functions work together to build quality into the products or services [18:208]. Firms can achieve a competitive advantage through TQM by eliminating the work of discovering and correcting errors. These activities cost up to 25 percent of gross revenue in a manufacturing company and 35 percent of the operating budget in a service organization [10:25]. The cost accounting systems must support the TQM effort by (1) providing financial and nonfinancial information regarding key processes in the firm; and (2) tracing the cost savings made possible through quality to specific products and suppliers.

The cost accounting system must provide nonfinancial as well as financial information to support TQM. The nonfinancial information enables management to determine what went wrong, the activities or work processes contributing to the problem, and where to concentrate action [10:24]. Management can use the nonfinancial information to eliminate unnecessary activities and identify opportunities for potential error [18:154]. The nonfinancial information also becomes a major input into the organization's

performance measurement system [142:199-201]. The nonfinancial inputs would provide visibility regarding measurable elements such as the number of reworks, scrap, or rejected parts. The cost system should then have the capability to trace costs to the activities involved and compute the total cost of nonconformance to the firm [10:24].

Effective TQM will also require the capability to trace cost savings to specific products or suppliers. Tracing is the assignment of costs based on specific data [142:274]. Tracing quality costs, or cost savings, to products or suppliers provides several benefits to the organization. First, it provides the capability to distinguish between heavy users and light users of an activity [18:163] such as rework or inspection. Users with high rework or inspection costs resulting from poor quality become candidates for further quality improvement [142:144]. Second, it provides an input into the performance measurement system [142:118]. Performance measures for an activity can include the number of inspections or material-related problems encountered by downstream activities. It also enables managers to go one step further and compute the cost of the defects [142:89] and their impact on the total cost of a product or service. Third, tracing overcomes the problems of cross-subsidization [18:163]. Cost benefits obtained by eliminating defects or non-value added activities, such as quality inspection,



within the manufacturing process of a specific product are not diffused across all products [142:29-32]. And fourth, organizations can trace quality costs to modify behavior [144:29] [18:22]. Management can influence behavior by assigning higher costs to undesirable activities [144:29]. Cost centers will react by changing their processes to avoid the cost assignment either as a charge to their organization or as a performance measure.

#### TQM Summary

The TQM emphasis has placed new demands on the cost accounting system for nonfinancial information [10:24]. Managers require the nonfinancial information to identify improvement opportunities and to focus action. Nonfinancial information enables managers to identify nonvalue-added activities and streamline their operations [18:154]. The cost system must also have the capability to trace costs to specific suppliers or products. Tracing allows managers to determine the impact of quality improvement actions on product cost, avoid cross-subsidization, and influence organizational behavior [18:22] [142:29-32] [144:29].

#### Continuous Replenishment Inventory Systems

Implementation of a continuous replenishment system, such as a just-in-time (JIT) system, significantly alters an organization's underlying operations, and implementation of

such a system may require an accompanying change in the accounting system [59:4] [75:48]. The organizations will require cost systems which identify waste, isolate cost drivers, and provide visibility of cost reduction or performance improvement opportunities [18:43].

Implementation will also require long-term relationships with suppliers [59:7], and the relationships must be developed to reduce the total cost of ownership [22:42]. The cost of ownership considers not only the purchase price but also other costs such as purchasing, holding, poor quality, and delivery failure [22:42-43].

Traditional cost systems appear seriously deficient for supporting changes in the manufacturing environment [75:43] [59:4-5]. They encourage inappropriate behavior and fail to provide the information management needs to make sound decisions and improve competitiveness [75:43]. Traditional systems generally track only the purchase price associated with a particular part or supplier and bury the costs of ordering, expediting, receiving, and inspecting in overhead accounts. The traditional approach encourages purchasing managers to select the lowest bidders even though the lowest bids may not represent the best overall value in terms of cost, quality and delivery [22:42]. Traditional cost systems also do not provide the nonfinancial information necessary for promoting process improvement and cost reduction [142:28] [143:30]. Manufacturing experience with

JIT illustrates how a continuous inventory replenishment system may drive changes in a cost accounting system.

JIT systems focus on cutting cycle times and eliminating waste [18:37]. The elimination of waste and nonvalue-added activities focuses attention on compressing time out of the manufacturing process [18:41] [75:48]. As a result, the accounting system must possess the capability to identify waste or nonvalue-added activities. Turney provides the following definition of a nonvalue-added activity [145:317:

An activity that is judged not to contribute to customer value. Also, an activity that can be eliminated without reducing the quantity or quality of output. An example is the activity of moving parts back and forth.

The reduction in lead times places a premium on the timeliness of data to control costs [59:11]. The cost system must also respond by compressing the time required to obtain management reports and for updating vendor cost and performance data.

Foster and Horngren provide a detailed discussion of the impact that JIT could have on cost accounting, and they identify the following implications resulting from JIT implementation [59:6-7]: (1) It increases the direct traceability of costs. Firms frequently dedicate facilities, equipment and personnel to the handling of a specific production line or retail area. (2) It changes

the cost pools used to accumulate costs. JIT eliminates or reduces several traditional cost pools such as warehousing or materials handling. (3) JIT changes the bases used for allocating indirect costs. Bases such as warehouse space lose their relevance while others, such as the number of deliveries, more accurately capture the cause and effect relationship. (4) Implementation reduces the emphasis on individual purchase price variance information. Firms attempt to achieve price reductions through long term relationships with suppliers rather than seeking one-time quantity discounts. (5) JIT reduces the frequency and detail of purchase deliveries in the internal accounting system. Firms attempt to reduce the cost of processing information in their accounting systems by batching individual actions, or reorganizing functions such as accounts payable.

#### Continuous Replenishment Summary

The implementation of a continuous replenishment system will drive new requirements for an organization's cost accounting system. The cost accounting system must identify opportunities for process simplification and reducing cycle times [18:37]. Organizations will also require timely and accurate cost information from their cost accounting systems for making cost trade-offs, making purchasing decisions, and evaluating potential suppliers and customers.

### The Need for a New Cost System

The implications for cost accounting systems resulting from changes in the business environment suggest the need for a new cost system. However, many organizations confront the problems of determining when a change in cost accounting systems is needed and what objectives a new cost accounting system should attempt to achieve. The following review addresses these key issues.

Cooper identifies two ways of determining whether a firm may need to change its cost accounting system [36:77]. One way examines the changes occurring in the organization and in its environment since implementing the existing cost accounting system. The previous discussion on changes in the business environment includes the changes identified by Cooper. The second way suggests that firms can recognize when a change is needed in their cost system. Cooper contends that a cost system will not become obsolete overnight, and an obsolete system will send many warning signals. Management must know how to recognize and read those signals. A firm should consider redesigning its cost system when [36:77-79]:

- Functional managers want to drop seemingly profitable lines.
- Profit margins are hard to explain.
- Products that are hard to make show high profits.
- Departments use their own cost systems
- The accounting department spends too much time on special projects.
- The company has a high-margin niche to itself.
- Competitors' prices are unrealistically low.

- Customers do not complain about price increases.
- The results of bids are hard to explain.

Eiler, Goletz, and Keegan provide a similar set of warning signals or symptoms of aging cost systems. Their list includes several unmistakable signs observed in an accounting system that is in trouble [53:134]. The most obvious signs, and those most visible to top management, include large inventory adjustments, high overhead rates, large manufacturing variances, and large accounting staffs frequently performing special studies. Less obvious but detectable signs include middle management's inability to explain the cost system in depth, awkward transfer pricing, great relief when the physical inventory does not require adjustment, and lack of interest in the budgeting process. Other symptoms require a detailed analysis and consist of poor analysis of manufacturing variances, little integration between manufacturing and the cost system, incorporation of "factors" in product cost buildups and inventory entries, and improper naming of cost elements.

Brimson identifies four common reasons why firms have implemented new accounting systems [18:20]. First, firms require more accurate product costs to support managerial decision-making. Product costs play a central role in pricing, estimating, and make/buy decisions. Second, the cost system must effectively manage cash and liquidity. Cash and liquidity enable the firm to adapt, capitalize on

opportunities, and weather turbulent environments. Concentration on cash and liquidity enables a firm to avoid waste and sloppy business practices such as high work-in-process inventories. Third, the firms seek effective cost control to optimize performance. Cost information should ensure the activities of the firm support corporate objectives. And fourth, the cost system should facilitate decision-making such as estimating, make/buy, pricing, and design-to-cost. The accounting system should provide timely information with sufficient detail to make decisions.

The organization must also consider what objectives a new cost system should achieve before electing to redesign or select a new cost system [53:135-136]. Johnson and Kaplan suggest that a cost system has four basic functions [81:227-228]:

1. Allocate costs for periodic financial statements
2. Facilitate process control
3. Compute product costs
4. Support special studies

Clemens provides a similar purpose for a cost system with greater emphasis on performance measurement. He states "A cost management system is designed and used for planning and control by the management of a company. The information from this system should identify the resources consumed in the performance of significant activities. . . . The system also should measure the efficiency and effectiveness of those activities" [25:43].

Brimson, Tyndal, and Eiler et al. recommend additional objectives the new cost system should attempt to achieve. Eiler, Goeltz, and Keegan include the objectives of physical control, identifying variances, integrity of inventory accounts, and management information [61:135-136]. Brimson's recommendations concentrate on the management of the firm's key activities and include the analysis of activity investment, cost drivers, activity budgeting, nonvalue-added activities, best practice, activity target cost, and strategic activities [18:62-65]. Tyndal identifies several characteristics the new cost system should possess to provide effective cost information for logistics managers. His objectives include comprehensive information to include all relevant costs and assets, comprehensive scope to include all major activities affected by management decisions, detailed cost categories, simultaneous data capture, sophisticated cost allocation, and logistics support analysis [150:58-60].

### Summary

The changes in the business environment and their implications for cost accounting were reviewed in Section One. The review also covered factors a firm should consider in determining when to change its cost system and the objectives the new or revised system should achieve. Section Two will review activity-based costing, a cost



system which has evolved in response to the many changes occurring within business during the past two decades.

## Section Two

### Activity-Based Costing

Section Two describes the activity-based costing (ABC) concept. The section defines ABC, describes how an ABC system operates, and identifies the cost and process dimensions of ABC.

#### Definitions of ABC

Cooper identifies ABC as a product costing technique representing an evolutionary extension of the two-stage allocation procedures underlying most modern cost systems [31:45]. Turney defines ABC as "A method of measuring the cost and performance of activities and cost objects. Assigns costs to activities based on their use of resources, and assigns cost to cost objects based on their use of activities. ABC recognizes the causal relationship of cost drivers to activities" [142:315]. Computer Aided Manufacturing-International, Inc. published a similar definition in the *Journal of Cost Management* "A methodology that measures the cost and performance of activities, resources, and cost objects. Resources are assigned to activities, then activities are assigned to cost objects based on their use. Activity-based costing recognizes the

causal relationship of cost drivers to activities" [121:57]. Chaffman and Talbott provide a comparable definition which recognizes the relationships inherent within ABC: "An ABC system analyzes overhead to determine activities and drivers. Once cost drivers are established, the overhead is allocated to the cost objective based on the volume of its driver" [23:15].

Brimson and Computer Aided Manufacturing International, Inc. offer slightly different definitions for cost accounting systems incorporating ABC. Brimson uses the term activity accounting and defines it as "The collection of financial and operational performance information about significant activities of an enterprise" [18:203]. Computer Aided Manufacturing, Inc. developed the following definition for ABC accounting, "[Activity-based accounting is] a collection of financial and operational performance information dealing with significant activities of the business. Activities represent repetitive tasks performed by each specialized group within a company as it executes its business objectives" [15:7].

Activities play a major role in each of the ABC definitions, and, as Brimson states, "Activities form the foundation of cost management systems" [18:47]. Activities became the basis of cost management because they provide an appropriate level of detail. Activities explain what a firm does. In contrast, functions aggregate too much information

and only show what gets done, whereas tasks provide too much detail by explaining the steps accomplished in an activity [18:48]. Brimson defines an activity as "A combination of people, technology, raw materials, methods and environment that produces a given product or service. Activities describe what an enterprise does: the way time is spent and the outputs of the process" [18:203]. Turney offers a more concise definition for an activity: "A unit of work performed within the organization. A description of the work that goes on in the organization and consumes resources" [142:315].

Activities will differ in type, number and location between companies. The differences exist because of the variations between companies and their business approach [142:99-100]. Brimson points out activities can cross functional boundaries. "The total spectrum of activities related to the function is much broader than the organizational unit that has primary responsibility for the function [18:47]." He also indicates "There is no requisite interdependency among the activities in a function other than relating to a common purpose" [18:47].

The ABC and activity definitions highlight a major assumption of ABC. "ABC assumes activities cause cost and that cost objects create the demand for activities" [142:51]. The assumption enables ABC to determine product

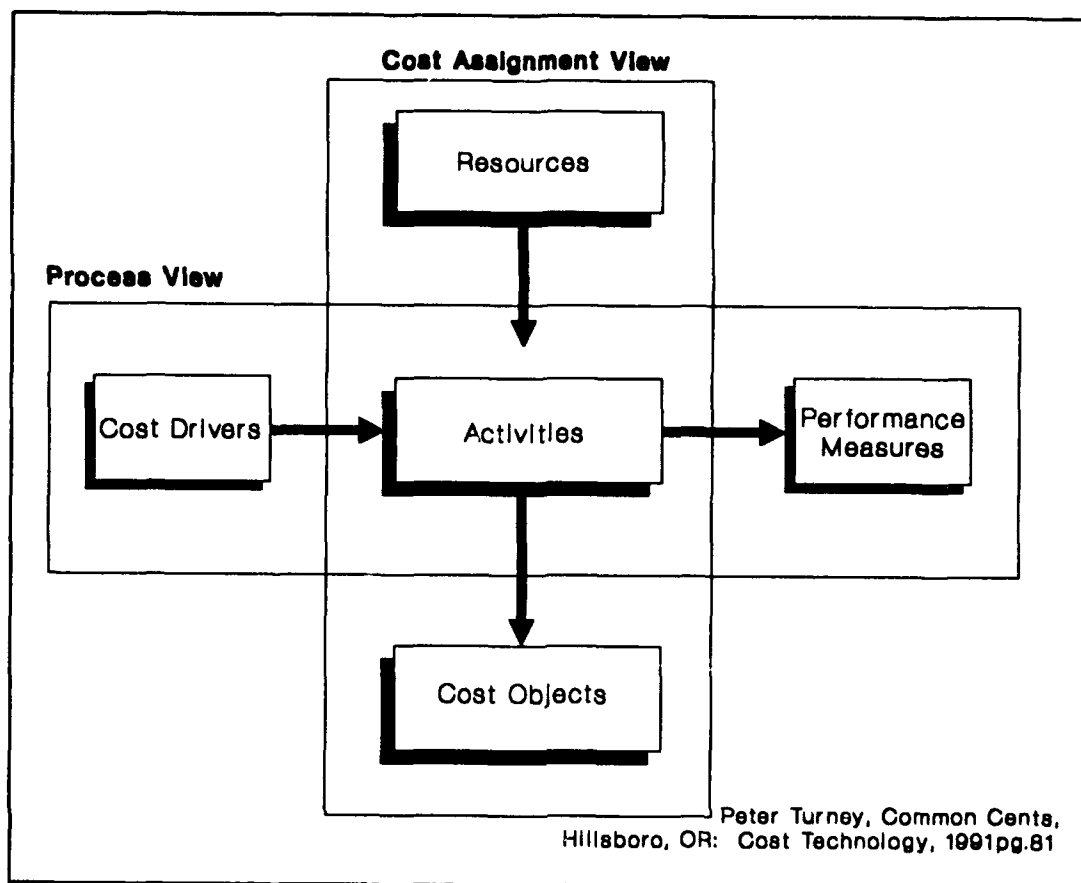
costs by summing the costs of all activities required to manufacture or deliver a product [31:46].

### ABC Dimensions

ABC development has progressed to include dimensions other than product cost. Sharman identified the use of a three-dimensional ABC model. One dimension focuses on product cost. The second dimension measures activity costs or the firm's costs to perform key activities. The third dimension includes the business process or driver costs. He cites an example of the third dimension as the costs of planning, procuring, and maintaining a raw goods portfolio of 4,000 components [131:10]. Turney has developed a two dimensional ABC model. The two dimensions, as shown in Figure 1, include a cost assignment view and a process view. The process view reflects the new information required by an organization to determine what causes work and how well it is done [142:81]. He refers to the two-dimensional model as second-generation ABC. His model captures the dimensions mentioned by Sharman, and the following review adopts Turney's two-dimensional approach.

#### The ABC Concept — Cost Assignment Dimension

ABC uses the assumption of activities causing cost and cost objects consuming activities to trace costs from activities to products based on each product's consumption



**Figure 1.** Two Dimensions of ABC [142:81]. Reproduced with permission of Cost Technologies, Hillsboro, OR.

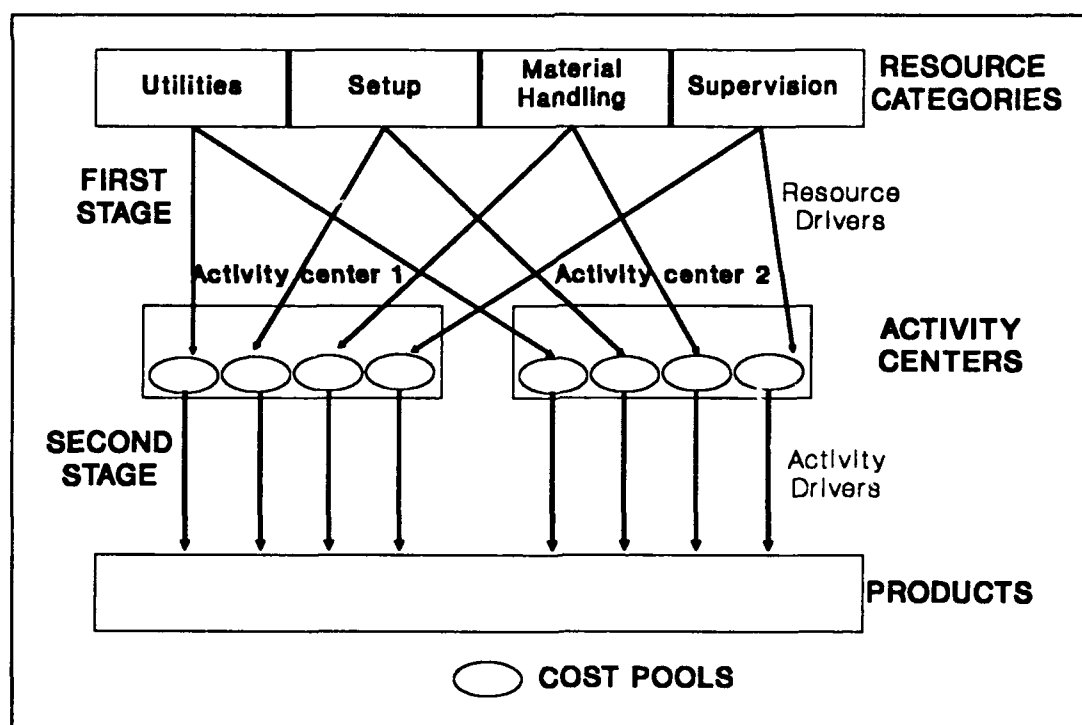
of the activities [28:86] [31:45]. The approach enables ABC to provide management with are relatively accurate attribution of indirect costs to product cost and therefore a better understanding of profitability. ABC expands management insight by also providing cost information on major activities undertaken by the business as well as the cost of business processes [131:8]. Cooper uses a two stage allocation procedure to illustrate cost relationships

between ABC's major components and the assignment of costs to a cost object [9:52]. The two stage allocation procedures is illustrated in Figure 2.

The first stage of the allocation procedure focuses on determining the activity costs within the organization.

Cooper describes the process as:

The first stage takes such resources as direct labor and supervision and splits them up into sections, each related to a segment of the product process. These segments can be machines, . . . collections of machines, or even entire departments. . . [55]



**Figure 2.** Conceptual Model of an Activity-Based Costing System [9:53]

Sharman uses a similar explanation. ABC identifies the activities performed by an indirect organization and calculates the cost incurred to perform each activity [131:9].

Beaujon and Singhal provide a more general description of the first stage:

The first process is splitting apart, or disaggregating, dissimilar resources, activities, and products to capture important differences in the ways resources are consumed by activities and products [9:54].

Turney uses a similar approach for describing the first allocation stage by establishing a relationship between resources, resource drivers, and activities. Resources are the economic elements directed to the performance of activities and are the source of cost [142:96]. Resources include the direct and indirect costs of production and non-manufacturing costs such as sales, general, and administrative (SG&A). Resource drivers are the mechanism used to assign costs to activities [142:97]. Costs flow to activities based on their consumption of the resources.

Borden provides an example of how costs would flow through this relationship.

As an example, assume that there are two support departments, A and B. A incurs \$80,000 of costs, and B incurs \$200,000. If 10 percent of A's efforts go toward processing purchasing orders, then a cost pool for purchase order activity might be established and 10 percent (or \$8,000) of A's costs would go into this pool. If B spent 30

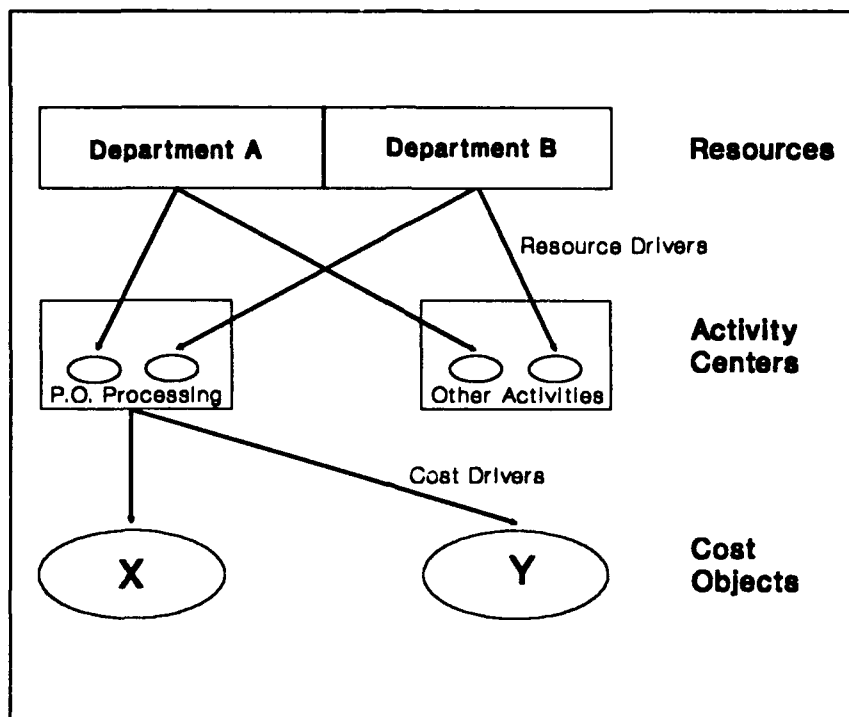
percent of its efforts on purchase orders, then 30 percent of its costs (or \$60,000) would also go into the purchase order activity pool. The remaining costs in each support department would be treated in the same manner by setting up cost pools to reflect the activities that the two support departments are engaged in performing [15:9].

Several authors use the concept of a cost pool to complete the first stage of the ABC cost assignment process. Beaujon and Singhal use cost pools to split up resource categories among activity centers, and one cost pool will exist for each resource category in an activity center [9:52]. Brimson defines a cost pool as "A grouping of costs caused by the same activity measure for the purpose of identification with or allocation to cost centers, processes, or products" [18:204]. Cooper similarly states "Each activity cost pool contains the total cost of performing that kind of activity on all of the products" [34:40].

Management may combine cost pools for similar activities together into activity centers. Brimson defines a cost, or activity, center as "The smallest unit of an organization for which budgeted or actual costs are collected and which has some common characteristics for measuring performance and assigning responsibility" [18:204]. Activity centers have a physical meaning to the user and play an important role in interpreting the data [9:54]. Management frequently uses activity centers to



report, manage, and measure the costs of performing individual or similar activities [34:41].



**Figure 3.** Illustration of Borden's Cost Assignment Example [15:9].

Figure 3 is a graphical illustration of the ABC Cost Assignment Model using the example developed by Borden. Costs flow from the resource categories to the activity cost pools based on the resource drivers or the consumption of resources by the activities. The bottom portion of the model demonstrates the second stage of the cost assignment process, the assignment of costs to a cost object.

The second stage of the cost assignment process traces costs from the cost pool to the product, or cost object, using a measure of the quantity of the resources consumed by the product [35]. Cost drivers act as the allocation bases in the second stage [34:40] and measure the activities performed on the cost object. "The term 'cost driver' indicates that the products drive the consumption of resources and should be charged for doing so. The cost drivers chosen reflect the activity that takes place in the various cost pools" [15:9].

The assignment of costs to the cost objects completes the two-stage process. A cost object is "The reasons for performing an activity. Cost objects include products, services, customers, projects, and contracts" [142:316], and they are the final point to which costs are traced [142:98]. The cost object's total cost would equal the sum of the costs of all activities required to manufacture and deliver the product or service [31:46].

The example provided earlier by Borden also describes the second stage process of assigning costs to a cost object:

To continue the example, assume that 100 purchase orders are received. Of these, forty orders are for product X, twenty for product Y, and two orders are for each of twenty other products. X would, therefore, be charged with 40 percent of the costs accumulated in the purchase order activity pool (or \$27,200). Similarly, Y would be charged with 20 percent of the costs (or \$13,600). By following this two-stage procedure, the costs

from the support departments are allocated, or assigned to individual products [15:9].

Brimson and Turney also introduce the concept of a bill of activities to reflect a product's total cost and activities consumed in producing the product or service [18:187] [142:132]. The bill of activities (BOA) reports the cost for each product and contains information about the activities, the order of the activities, activity drivers, and cost of a product [142:132-133]. The BOA resembles a bill of materials but differs by listing activities and their respective costs. Management can use the BOA analysis to trace the quantity and cost of activities required for a product or service, a group of products, or the entire enterprise [18:186-187].

#### Cost Assignment Dimension Summary

The cost assignment dimension of ABC incorporates a two-stage cost allocation procedure [9:52]. The first stage of the process traces resource costs to the key activities of the organization by the amount of resource actually consumed by the activity [9:54] [142:97]. The second stage traces activity costs to cost objects based on the work performed or activities consumed by the product or service [34:40]. The allocation process determines a cost object's total cost by summing the costs of all activities required to manufacture and deliver the product or service [31:46].

### The ABC Concept — Process Dimension

Sharman suggests accounting principles and practices have continued to evolve during real-life applications, and ABC represents no exception to this rule. ABC users have discovered new ways to apply the cost information to the management of their firm's activities. "They use ABC to identify the cost of processes and activity drivers, thereby obtaining information they can utilize to drive process change and assign priorities to their cost reduction efforts" [133:22].

Turney includes a second dimension, the process view, in his ABC model to accommodate the use of ABC's nonfinancial information. The process view contains information about why work is done and how well it is performed [145:47]. The process dimension also includes information about the cost drivers and performance measures. The information assists management in interpreting and improving activity performance [142:85-86].

ABC's cost driver information promotes process reengineering and cost reduction by reflecting the demands placed on activities for products [143:30]. Cost reduction within the firm can only occur by a reduction in cost drivers or the causes of resource commitment [114:43]. Products or services with high resource consumption patterns become targets for reengineering or redesign to reduce resource consumption. Cost reduction and process

improvement can also occur through the evaluation of alternatives at the activity level. Improvements and cost reduction can result from (1) activity reduction, reducing the time or effort required to perform an activity; (2) activity elimination; (3) activity selection, selecting a lower cost alternative; and (4) activity sharing, achieving economies of scale by having multiple products share activities [143:31].

Ostrenga and Cooper raise two concerns regarding the focus on activities to reduce costs. A reduction in cost drivers must accompany any activity improvement efforts to achieve a meaningful and long-lasting cost reduction [114:43] [41:134-145]. Cost savings will not materialize until the firm either reduces or redeploys the excess resources to a more productive area [114:43]. Cooper emphasizes the need for management action to capture the benefits from the signals an ABC analysis sends. Failure to reduce the cost drivers will only result in excess capacity and not improved profits [41:135].

Cost drivers can also affect performance by modifying behavior [33:44] or focusing attention on one or two critical aspects of manufacturing excellence [144:29]. Cooper recommends that firms consider the effect a particular cost driver will have on the behavior of individuals within the firm. The cost driver will affect behavior if the individuals perceive that the cost driver

information will affect their performance evaluation. Brimson shares this viewpoint but cautions companies to consider how the selection of an activity measure might result in changes in organization behavior that conflict with the firm's strategic goals [18:23]. Cooper warns against underestimating the behavioral impact and suggests some firms can justify an ABC system on behavioral grounds alone [33:44].

Performance measures can fill several roles in ABC. "Performance measures describe the work done and the results achieved in an activity" [145:47]. Ostrenga contends that performance measures assist the cost reduction effort by focusing on the significant activity levels and measuring activity drivers. The establishment of baselines and targets enable performance measures to track the impact of change promoted through operational improvements [114:46]. Turney also suggests using benchmarking to track performance goals within the company against the "best practice" of performing the function or process. Benchmarking or comparisons to best practice enables the firm to gauge how well it performs activities and to identify areas requiring further improvement [142:111-112]. He also recommends using performance measures to address operational questions such as:

- What events trigger the performance of the activity?
- What factors negatively affect the performance of the activity? and
- How efficiently, how fast, and with what quality is the work carried out [142:89]?

Managers can combine the financial and nonfinancial information available or tracked within ABC to address these questions and in the development of performance measures [114:46]. ABC has most of the information available in the form of the activities performed, the length of time required, resources consumed, and product costs. Management can focus on high cost or time consuming areas for improvement [76:28]. The available financial information also facilitates measurements of the negative aspects of an activity, such as the cost of defects, or cost savings achieved through quality or other improvement efforts [142:88-89]. Turney has applied the term activity-based management to refer to the combination of financial and nonfinancial information to improve a business [142:139].

#### Process Dimension Summary

The process dimension of ABC provides a framework for reengineering the work done within the organization and evaluating performance [145:47]. The nonfinancial information provided by ABC facilitates the performance measurement process by reflecting the demands placed on activities by products [143:30]. Demand information enables

management to target high consumption patterns for reengineering or redesign to reduce resource consumption [114:43]. The nonfinancial information also provides a means for benchmarking results against best practice [142:111-112] or modifying behavior within the organization [18:22] [33:44] [144:29].

### Section Three

#### Comparing ABC and Traditional Cost Systems

The literature makes several distinctions between ABC and traditional cost accounting. Most of the literature focuses on the differences in product costing, treatment of fixed and variable costs, variance reporting, and availability of nonfinancial data to support decision-making.

#### Product Costing

ABC and traditional cost accounting differ in the approaches taken to determine product costs. Cooper and Kaplan summarize the two approaches by examining the processes used to allocate overhead costs to a cost object:

Traditional cost accounting systems use bases like direct labor and machine hours to allocate to products the expenses of indirect and support activities, including engineering changes, setups, and parts maintenance. In contrast, activity-based costing segregates the expenses of indirect and support resources by activities. It then assigns those expenses based on the drivers of the activities [41:131].



The summary identifies two differences in the allocation bases used by ABC and traditional cost systems. First, the two approaches have different assumptions regarding how costs are incurred. Traditional cost systems assume products cause costs to be incurred [31:45]. ABC assumes products incur costs according to the activities they require [15:8] [18:13]. Second, they differ in the number of cost drivers used to allocate overhead costs.<sup>1</sup> Traditional cost systems typically use one, and at most three, second-stage allocation bases. Direct labor hours, machine hours, or material dollars are the most commonly used [31:45]. ABC systems use multiple cost drivers to trace the cost of production activities in a process to the products that consume the resources used in those activities [33:34]. The differences between the allocation bases will affect the ability of the systems to accurately report product cost.

Traditional cost systems will accurately report product costs when a strong correlation exists between production volume and resource consumption [18:8] [142:30] [31:48]. Brimson uses the correlation between fringe benefits for direct labor employees and direct labor cost to illustrate a

---

<sup>1</sup>ABC literature frequently interchanges the terms "overhead" and "indirect costs." The convention adopted in the study is to use the term "overhead" when discussing traditional cost accounting systems and "indirect costs" when discussing ABC systems. The distinction reflects the capability of ABC to trace indirect costs to the cost object.

strongly correlated relationship. He also indicates the traditional cost model will distort product costs as indirect costs not related to volume increase in magnitude [18:8].

The unit level cost drivers used in traditional cost systems will distort product cost when product diversity exists [9] [18] [31] [39] [53] [81] [108] [131] [142]. Cooper defines product diversity as differences in the product's production volume, size, complexity, material, and setups [31:45-53]. Cost distortion results when a traditional cost system attempts to allocate non-volume related indirect costs between diverse products using a unit-level allocation basis. The unit-level basis also will distort product costs by failing to recognize a hierarchy of resource consumption patterns existing at the unit, batch, product, and facility levels [41:132].

Brimson provides an example of how differences in product diversity would affect product cost.

. . .consider a procurement department that spends \$120,000 processing 6,000 purchase orders. The average purchase order is \$20. The complex product requires \$400 (20 purchase orders @ \$20) of the purchase order activity, whereas the simple product requires \$20 (one purchase order @20)—a dramatic difference [18:14].

A traditional cost system would assume both products consume the procurement resources based on production volume and would not recognize differences in actual consumption. Each

product would receive an equal share of the procurement department cost based on direct labor, machine hours, or materials costs. As a result, the traditional cost model would distort the products' costs by overcosting the simple product and undercosting the complex product.

ABC overcomes these sources of cost distortion and provides more accurate costs by tracing resource consumption to activities and using multiple second stage cost drivers to assign costs to the cost object [18:12-14] [31:45-53] [33:34] [78:42] [142:95-110]. The number of activities and cost drivers used in an ABC system will reflect on the desired accuracy of the reported costs and the complexity of the organization's product mix [33:35]. Turney uses the two-stage allocation process to explain how ABC improves cost accuracy. The first stage assigns costs to activities based on the measurements of resources consumed. He notes traditional models generally do not identify activities and cannot trace consumption based on activity usage. The second stage assigns activity costs to cost objects based on activity drivers that accurately measure consumption of the activity [142:53-54].

The product costs reported by an ABC system and a traditional cost system can differ dramatically. Cooper found the change in costs assigned to products varied from -50 percent to +200 percent [29:40]. Turney has commonly found the ABC costs low volume-high variety products may

range from 1 to 600 percent greater than the costs reported by a traditional cost system. In contrast, high volume-low variety products may have ABC costs of 10 to 80 percent below those reported by a traditional system [142:4].

Sharman similarly found significant over- and under-costing to exist in the costs reported between an ABC system and a conventional cost accounting system used by a telecommunications firm [131:11]. Ostrenga also found significant cost changes in a client's product costs. The client had 80% material and 20% conversion cost at the plant level. Despite the small amount of non-material cost to reassign to products, ABC implementation produced significantly different product costs. Cooper notes that the distortions will vary according to how well a company has designed its traditional cost system. However, his comparison of ABC and traditional product costs found average product cost changed by 24 percent under ABC even when using a well or appropriately designed, traditional cost system for the examined company [29:40].

The cost distortions reported by the traditional cost system have serious implications for an organization. The cross-subsidization of indirect costs will make low-volume, high cost consuming items appear profitable and high-volume, low cost consumption items appear unprofitable [40:97-98] [142:39-44]. Management decisions based on the inaccurate cost information will result in pricing errors, the

concentration of marketing and sales on products actually generating a loss to the firm, and the possible elimination or outsourcing of products generating the most profits to the firm. Cooper and Kaplan indicate that allocating costs to individual units sends signals that management easily can misinterpret. Management may infer that indirect costs actually vary with the unit level cost driver. As a result, cost center managers and product managers have their cost-reduction attention directed solely to direct labor. Johnson and Kaplan note ". . .it is not unusual to see thousands of dollars of industrial engineering time devoted to saving tenths of hours of direct labor time" [81:188]. Using this system, managers will likely focus little attention on indirect costs, the costs which are increasing most rapidly [81:188] [41:132] [64:12].

#### Treatment of Fixed and Variable Costs

Traditional cost accounting and ABC differ on the treatment of fixed and variable costs [18:111-118] [41:135] [124:7] [142:121-124]. Traditional cost accounting uses the categories of variable and fixed costs to reflect their behavior. Variable costs are assumed to vary with production, frequently traced directly to the cost object, and included in management decision-making. Fixed costs do not vary with volume, are not traced or allocated to specific products, and do not enter into future decision-

making [18:111-115]. ABC does not make a clear distinction between variable and fixed costs. Instead, ABC introduces the concept of long-term variable costs (LTVCs). The LTVC concept recognizes that most variable and a large proportion of fixed costs actually do vary with the number of transactions (e.g., machine setups, shipping orders, or scheduling) [15:8] [41:135] [142:124]. Ames and Hlavacek advocate a similar approach using "managed fixed" costs. They also contend a large proportion of "lumpy" costs are controllable and distinguishable from common costs shared in the organization [5:144]. The differences in the treatment of fixed costs will affect how the two systems determine product costs and influence future decision-making.

Traditional cost accounting includes fixed costs as part of overhead but excludes fixed costs in future decision-making. Brimson contends traditional cost accountants have a reluctance to trace or allocate fixed costs to specific products because they do not perceive them as short-term controllable or impacting short-term decisions [18:116]. Fixed costs appear as an overhead cost, and a unit-level cost driver assigns the costs to all cost objects. Traditional cost accounting considers fixed costs not varying with production as sunk costs in future decisions and uses contribution analysis to select a mix of products contributing the most to covering fixed costs [18:117].

ABC relies on direct traceability of LTVCs to determine product costs and provide information required for future decision-making. The tracing of LTVCs to the cost object provides several advantages for product costing and decision-making. ABC eliminates the cross-subsidization between products, and products with low fixed costs can more effectively compete. The company can more accurately price the products to seek a return associated with investment in the product [18:117]. Management can focus on managing LTVCs by analyzing cost drivers and taking action to reduce demands on organizational resources [18:117] [5:144] [41:135] [124:7]. Traceability also provides a clearer picture of how costs and profits behave with changes in unit volume [5:144]. Cooper and Kaplan recognize that the tracing of all fixed or overhead costs may not prove feasible and recommend two exceptions. The first consists of research and development costs for new products. The second includes excess capacity [40:101].

### Variance Reporting

Traditional cost accounting and ABC differ in the approaches taken to measure and report overhead variances [37:3]. Variance reporting plays an important management role by providing benchmarks for operational and financial managers to measure the effectiveness of manufacturing and marketing performance. Variance reporting compares before-

the-fact product cost, production, and sales standards and compares them to after-the-fact results [17:43].

Traditional accounting reports overhead variances in aggregate terms [37:3] and uses unit-level measures to compute the variance [37:3] [134:675]. ABC takes a different approach by comparing the resources supplied against the resources consumed, or unused capacity [37:3].

Traditional cost accounting determines overhead cost variances by assigning a standard overhead rate to production volume [134:675]. The cost accountant computes the standard rate by dividing total expected overhead cost by the budgeted activity level. The approach assumes no relationship exists between overhead and the specific units produced; rather, the overhead costs are common costs and benefit all products. They must therefore be assigned to production based on a predetermined (standard) overhead rate [134:675].

Cooper and Kaplan recommend unused capacity as the means for evaluating capacity utilization. Unused capacity represents the difference between the cost of activity supplied and the cost of activity used [37:3], and the difference does not represent a cost in performing the activity [37:6]. The approach assumes the cost of supplying the resources to be fixed during the short run, such as the resources required to process purchase orders, but the quantity of resources used during each period may fluctuate



based on activities performed or outputs produced. Activity-based systems measure the cost of using these resources even though they may not vary, in the short run, with usage [37:2].

Cooper and Kaplan identify several differences between the two approaches. First, traditional volume variances only report figures in aggregate terms and do not identify the quantity of resources supplied or used. ABC reports both the quantity and the cost of unused capacity. Second, traditional volume variances often use a volume based denominator based on budgeted production rather than practical capacity. ABC uses the practical capacity and not the anticipated or budgeted volume. Third, the traditional procedure of allocating overhead with a denominator volume proves useful only for inventory valuation and does not provide information relevant for management. Fourth and most importantly, the calculation used to measure volume variance uses a denominator, or allocation basis, which varies with the number of units produced. The approach assumes overhead costs occur in direct proportion to the allocation basis. The assumption can cause the traditional overhead reports to misstate variances for individual functions. The cross-subsidies resulting from a unit-level basis permit the reporting of no overhead variance for a period even while substantial surplus capacity may exist for many individual functions [37:3-4].

### Availability of Nonfinancial Data

The availability of nonfinancial data to support performance measurement and continuous improvement represents another major difference between traditional cost accounting and ABC. Nonfinancial information encompasses factors affecting activity workload and measures of activity execution [142:110]. Managers require nonfinancial information to measure activity performance, to identify improvement opportunities, and to understand what causes cost. Traditional cost accounting focuses almost entirely on financial reporting, and nonfinancial information lies outside the scope of a conventional system [142:28]. In contrast, ABC provides a variety of nonfinancial information affecting an organization such as the activities performed, cost drivers, and activity performance measures [142:218].

### Nonfinancial Information in Traditional Cost Systems

Traditional cost systems provide only limited amounts of nonfinancial information. Traditional systems were developed during an era when direct labor and materials represented the predominant factors of production, and management could rely on a limited number of cost categories to evaluate performance [18:7-8]. Compartmentalized standard costs and budgets defined the organization's financial goals, and cost analyses focused on controlling variances between actual costs and budgeted costs

[142:37, 150]. The approach concentrates exclusively on cost data and does not reflect the different types or quality of the work performed within the company [142:36] [68:37]. As a result, traditional cost systems cannot adequately identify the causes of cost within the organization or potential sources for competitive advantage [18:8-10]. "Nonfinancial information, about defects and throughput rates in each activity for example, is outside the scope of the conventional system" [142:28].

#### Nonfinancial Information in ABC Systems

ABC provides a substantial amount of nonfinancial information by using activities, performance measures, and cost drivers. ABC breaks down an organization into activities or the work performed and provides nonfinancial information regarding the individual activities [18:11] [142:51,83]. Management can use activities to measure organizational performance and cost drivers. Performance measures provide nonfinancial indicators of the results achieved in an activity [142:60]. The measures could consist of other activities, such as processing product returns, to provide performance feedback. Cost drivers contribute to performance measurement by reflecting the quantity of resources or activities consumed [142:95-110]. Resource drivers trace resource consumption to specific activities. Activity drivers trace activity consumption to

specific cost objects. The nonfinancial information provided by cost drivers includes the quantity and types of resources or activities consumed. For example, the cost drivers would trace the number of product returns and the quantity of resources consumed to the cost object generating the returns.

#### Management Implications

The availability of nonfinancial information has significant managerial implications. Brimson contends that changes during the 1980s will place nonfinancial and financial information on a plane of equal importance [18:44]:

Nonfinancial performance measures will achieve a level of importance equal to financial measures. Strategies such as time compression in product delivery systems require an ongoing monitoring of time. Process balance will be more important than machine usage; quick response to the marketplace becomes more important than machine usage or labor efficiencies. New performance measures will be developed at the activity level. Measures of capacity costs become critical. Bottlenecks in the product delivery system, whether in manufacturing or customer service, must be identified and evaluated as cost drivers. Companies must be able to measure improvements in the velocity of the manufacturing process, new product development, distribution, and customer service.

The availability of nonfinancial information promotes continuous improvement. Brimson indicates an organization typically has many non-value added activities — those

activities adding no value to the customer — and visibility of non-value added activities can act as a basis for continuous improvement [18:71]. Rotch found managers can use the linkages between outputs and activities to directly effect product decisions without dollar figures. He cites a circuit board manufacturer who discovered certain board designs required more hand work and recognized hand work would generate more costs and quality problems. The manufacturer changed the design and eliminated the activities requiring manual labor and driving quality costs [124:6]. Turney suggests continuous improvement can lead to a permanent reduction in cost by eliminating time and effort, the elimination or reduction of non-value added activities, using lower-cost alternatives, the sharing of activities, and redeployment of unused resources [143:29-35].

Non-financial information can also affect management decision-making in several other ways. Managers can compare their processes against the "best practices" of other firms to assess their progress or competitiveness [18:64]. Turney used nonfinancial information to identify and trace activities affecting the sorting process in an electronics firm. The tracing revealed the "hidden costs" of the sorting process by identifying activities supporting or affected by the process located elsewhere in the organization. He suggests the information could support

make-or-buy analyses or determining the cross-function impacts of changes in the sorting process [145:48-49].

### Comparison with Direct Product Profitability

#### Direct Product Profitability

The grocery trade developed direct product profitability (DPP) as a pricing technique during the 1960s and 1970s [105] [91:103]. DPP provided a technique for identifying the profit contribution of individual products by taking into account the specific handling and space costs incurred by an item [105:6]. Proponents of DPP suggested the approach would provide retailers and wholesalers with a better understanding of the profit implications of various merchandising and product-handling decisions [116:14].

DPP provided a significant advantage over traditional accounting practice for food retailers [105:6] [91:120]. Retailers had traditionally relied on gross profit and gross margin for measuring performance. However, these measures ignored how handling and storage costs can vary among items and ". . . how this shortcoming can produce misleading indications of profitability" [105:6]. DPP more accurately depicted product profitability by taking into account those costs directly affected by a product decision. Studies performed by McKinsey and Company found several instances where products that seemed profitable on a gross profit basis turned out to be marginal producers or losers on a

direct product profit basis. The handling and storage costs attributable to the products had virtually wiped out all of the higher gross profits [105:7].

DPP more accurately depicts product profitability by subtracting from gross margin those costs directly attributable to the product. DPP would include the cost of activities such as handling, freight, discounts, allowances, storage, and direct labor. However, DPP excludes "fixed" overhead costs such as supervision, facilities, management, detention, demurrage, purchasing, and inventory carrying costs [105:13].

The DPP approach requires the identification of all sales and costs directly attributable to a specific product [105:6] and the development of an extensive database of physical characteristics [91:120]. McKinsey and Company identified 25 basic steps for determining DPP within a firm [105:11]. The implementation steps obtain the sales, variable cost, and activity-related information by product. The DPP model uses the activity and cost information for developing cost coefficients. The cost coefficients reflect the per unit cost for product handling and storage activities. Dividing the activity cost by unit volume produces the cost coefficient. The DPP model multiplies, or divides as appropriate, the cost coefficients by product characteristics to determine total variable direct product costs. The coefficients may occur at multiple levels such

as case, unit, ring, pallet, order, and retail dollar for a single product. As a result, the DPP database must maintain product characteristics for each coefficient identified. The sum of the coefficients multiplied, or divided, by the product characteristics represents the total variable direct product costs. Table One provides an example of calculating a total variable product cost.

TABLE 1  
CALCULATING DIRECT PRODUCT COST PER CASE  
ADAPTED FROM MCKINSEY & COMPANY [105:16]

Formula Factor	Cost Coefficient	Product Characteristics	Total Cost Per Case
Per cubic foot of case size	\$.095	3.0 cubic feet per case	\$.285
Per case	\$.080	1 case	\$.080
Per unit	\$.003	24 units/case	\$.072
Per ring	\$.0025	24 rings/case	\$.060
Per pallet	\$.325	÷ 45 cases per pallet	\$.007
Per order	\$.010	1 case/order	\$.100
Per retail dollar	\$.030	\$8.00 retail dollars/case	\$.240
Total Variable Direct Product Costs:			\$.844

The firm can insert the total variable direct product cost into the product profit and loss statement to obtain product profitability. The firm can determine direct product profit by case by (1) subtracting the purchase cost per case from the retail sales per case to yield gross



profit per case, and (2) adding any cash discounts to gross profit and then subtracting the variable direct product cost [105:12, 16]. The approach excludes the "fixed" overhead costs included in net profit calculations [105:7].

#### Similarities Between ABC and DPP

ABC and DPP share a number of common characteristics. Both techniques attempt to provide a more accurate reporting of product costs [105:7] [142:51-61]. The techniques identify the activities performed in support of a product and attempt to directly trace the activity costs to the product [105:9-18] [49:61-66]. Management can use DPP and ABC information to determine the products providing the greatest contribution to profit, analyze alternative supply channels, and target specific activities for elimination or reduction [116:114] [142:173-175]. Despite these similarities, ABC and DPP differ on several key points.

#### Differences Between ABC and DPP

ABC and DPP significantly differ in several respects. ABC addresses the issue of how to assign overhead and indirect costs [91:120]; however, DPP excludes overhead and non-volume based costs [105:7,11-18]. DPP also has received only limited use ". . .because it has never been fully integrated into distributor's business systems" [91:120]. A major factor contributing to the limited use of

Factor	Direct Product Profitability	Activity-Based Costing
Product Costing	Unit level driver Direct product costs	Hierarchy of drivers Products incur costs Multiple cost drivers Handles diversity
Fixed Costs	Do not vary Not traced	Long-term variable Traced
Product Characteristics	Extensive database	Not required
Activity Analysis	Activities directly Impacting product	All activities Value-Added Focus
Nonfinancial data	Limited to direct activities	Substantial

**Figure 4.** Comparison of DPP and ABC

DPP stems from the requirement to maintain an extensive database of physical characteristics and to continually update the database [91:120]. ABC, on the other hand, does not use this information.

Kurt Salmon Associates, Inc. have identified four key differences between ABC and DPP. ABC:

- Provides accurate information on the full direct and indirect costs of business activities and practices.
- Identifies the cost of activities that add no value to the final customer.
- Supports category management by providing accurate profitability measures at the category, vendor, and item level.
- Objectively determines the costs and benefits of joint supplier/distributor ECR [Efficient Consumer Response] improvement activities [91:121].

### Criticisms of Activity-Based Costing

ABC has recently come under criticism as a larger number of individuals in the accounting profession and organizations explore the ABC concept. Fox suggests "ABC is a classic example of the gap between theory and practice. It has experienced some success in practice yet, as P&W [Piper and Walley] exemplify, traditional accounting or economics based theory has great difficulty in justifying the practice" [61:32]. Practitioners attempting to implement ABC have also confronted limitations to the approach. This portion of the literature review covers the criticisms and limitations of the ABC approach.

#### Criticisms of ABC Systems

Piper and Walley have made several criticisms of the assumptions and justifications used to support ABC [117] [118]. They contend decisions, not activities, cause cost [117:37]. Their review of ABC implementation indicates strategic decisions and not activities changed the cost structure within the organizations cited by ABC proponents. Their review uncovered no evidence to support the assumption of activities causing cost. They disagree with the assumptions made by Cooper regarding a change in activity necessarily driving a differential change in costs and use the following example to illustrate their position:

Consider, for example, that a reduction in production volume may not result in a reduction of cost in many indirect production areas, yet there may be a reduction in activity. This straightforward example would appear to demonstrate that activity does not have a clear causal relationship with cost, yet that is what ABC is founded upon [118:42].

They contend ABC also makes use of a limited sample of historical information and extrapolates this to a long-term situation. The extrapolation represents a serious deficiency of ABC particularly in a rapidly changing environment [118:42]. Piper and Walley continue their criticism by raising the issue of resource consumption versus cash flow.

Cooper argues that there is a relationship between consumption and cash flow, but this is lagged and differs on the type of resource. Our concern is that ABC assumes that changes in resource usage will result, in due course, in a change in cash flow. Cash flow is fundamentally important to organisations and the decision-relevant approach emphasises the prediction of future cash flows, and the monitoring of cash flows, thereby reviewing previous decisions [118:44].

They conclude ABC provides no evidence of modeling actual or potential cash flows, and it is changes in these cash flows which are ultimately of interest to corporate management [118:44,54].

Dugdale presents three criticisms of ABC. He presents the argument voiced by Allen regarding ABC's use of sunk costs [51:37]:

Theory dictates that sunk costs should be ignored in decision-making, yet ABC analyses are often based on existing structures. Allen has been particularly scathing of the backward-looking orientation of much ABC analysis.

Dugdale questions the relevance of tracing all costs to the product. He supports Morrow's position that it may be necessary to identify some costs as market, customer, or order related rather than product related. Costs associated with these categories require management by different criteria. Dugdale also suggests ABC ignores the use of opportunity costs. "An analysis which showed some existing products as profitable would take no account of possibly better alternative strategy perhaps based on new products" [51:37].

Cooper and Kaplan also identify the traditional cost system's ability to perform incremental analysis as a criticism frequently voiced regarding ABC [37:9]. ABC critics question the need for an ABC system when the capability already exists to calculate the changes in spending resulting from any contemplated decision, such as dropping or outsourcing a product. Cooper and Kaplan respond by stating:

. . .Managers cannot possibly apply introductory cost accounting relevant cost calculations to all possible product and customer mix decisions. The activity-based cost model, like the thermodynamics model, provides an aggregate view of the economic laws of motion of a complex enterprise, with thousands of individual products, customers, and facilities. . . .An activity-based cost model

serves to direct managers' attention to where more detailed analysis will likely yield the highest payoffs. The ABC model reduces the dimensionality of decisions to where the cash flow consequences from only a few alternatives need to be examined closely [37:9-10].

### ABC Limitations

Greenwood and Reeve identify two limitations within the current ABC methodology. They suggest the ABC literature does not contain a comprehensive methodology actually designed to relate cost and performance information to processes at the activity level. They also contend the cost simulation capability in present ABC systems are reactive in design [66:22-40]. Greenwood and Reeve proceed by proposing a framework to overcome these limitations within a manufacturing environment.

Roth and Borthick [125] also detected limitations in the ABC approach for determining product costs. Their limitations concern allocations, time periods, and omission of costs. They found the nature of some costs, such as building occupancy, still may require arbitrary allocation schemes. ABC must use arbitrary time periods for calculating product costs. Turney [142:59] and Cooper and Kaplan [41:133] identified similar limitations within ABC regarding sustaining or plant cost. Roth and Borthick also found a firm cannot wait until the end of a product's life to compute costs, and interim measures will require ABC to allocate costs rather than directly trace costs to the cost

object. They also indicate some costs that can be identified with specific products are omitted from the ABC analysis in manufacturing. The costs include marketing, advertising, research and development, product repairs, etc. The authors contend ABC could overcome these limitations by adding more activities or gathering more cost data. They suggest firms should consider performing a cost-benefit analysis before implementing changes to their ABC systems [125:32-33].

Innes and Mitchell suggest some questions on ABC merit additional investigation. They identify four areas requiring further research. First, little is yet known regarding the potential behavioral and organizational consequences of ABC. The new performance measures and cost data may profoundly affect an organization, and a proper investigation of ABC requires an understanding of the behavioral impact. Second, they share the viewpoint regarding ABC's historical focus and urge caution regarding ABC applications to future strategic decisions. Third, practical problems regarding the selection of cost drivers and cost driver commonality among products remains unsolved. Finally, Innes and Mitchell also have found little evidence to support claims ABC will improve corporate profitability, and ABC's impact on cost reduction and managerial decision-making require further exploration [77:29].

Johnson contends ABC will not help companies achieve continuous improvement of globally competitive operations [80:33]. He states ABC, or any other accounting system, cannot tell management if a customer is satisfied or if a process is under control or capable of satisfying customer expectations [80:31]. "ABC simply links activity with activity drivers and says: Reduce the amount of activity (hence, cost) for a given amount of revenue by reducing or "economizing" on activity drivers" [80:31]. ABC will enable the firm to improve "business as usual" but will not obtain the process improvements required to become globally competitive. Instead, Johnson argues companies should continually improve customer-focused processes. The companies will eventually discover ". . .their process improvements eliminate most of the 'overhead activity' that, by causing distortions in product costs, prompted the development of ABC tools in the first place" [80:33].

#### Summary of Traditional Versus ABC System Comparisons

The differences between traditional cost accounting and the approach adopted in ABC were reviewed in Section Three. Figure 5 is a summary of the key differences discussed within the section. A summary of the criticisms and limitations of ABC concluded Section Three. Section Four will further illustrate the differences between ABC and



<b>Factor</b>	<b>Conventional Cost Accounting</b>	<b>Activity-Based Costing</b>
Product Costing	Unit level driver Products cause costs Limited cost drivers Cannot handle diversity	Hierarchy of drivers Products incur costs Multiple cost drivers Handles diversity
Fixed Costs	Do not vary Not traced	Long-term variable Traced
Variance Reporting	Aggregate terms Unit-level computed Compares costs Volume based	Quantity and cost Activity driven Compares Resources Practical capacity
Nonfinancial data	Limited to none	Substantial

**Figure 5.** Comparison of Traditional Cost Accounting with Activity-Based Cost Accounting

traditional cost accounting systems by reviewing the implementation and design of an ABC system.

## Section Four

### Implementation and Design of ABC Systems

Cooper has found little literature exists on how to implement ABC systems [29:33]:

Apparently, practical applications of activity-based costing have become possible only recently. Only a few ABC systems have ever been documented, and the oldest of these is less than ten years old. Even less has been written about how to implement ABC systems.

The available literature discussing ABC implementation and design closely parallel the actions contained in the five implementation stages contained in Table 3. Turney identifies an implementation process also consisting of five stages ranging from approval to implementation of an operational system [142:207-208]. Cooper proposes a similar approach but recommends making several upfront design decisions before proceeding with implementation.

The five implementation stages contained in Table 3 will serve as an outline for reviewing the literature addressing the implementation and design of an ABC system.

#### Problem Definition Stage

Turney suggests an organization's introduction to ABC passes through three steps: (1) generate interest; (2) remove barriers to acceptance; and (3) obtain management approval [142:211]. Generating interest consists of identifying the problem and exposing ABC as a possible

solution to management. The removal of barriers to acceptance includes actions to overcome management preconceptions regarding ABC. The management approval step obtains commitment for the ABC project by demonstrating ABC can benefit the organization and the existing cost system has failed to provide accurate cost and performance information [142:210-221].

Cooper contends many firms have already recognized problems within their current cost accounting systems. He claims the systems ". . .give managers incorrect product costing information, or they inundate managers with irrelevant cost information, or they fail to measure the things that really count" [36:77]. Manufacturing firms have particularly encountered problems with their costing systems. Brimson suggests the changes in the business environment and the trends toward continuous improvement and JIT have caused existing cost systems to become obsolete and have placed new information demands on the cost system [18:26-27]. Eiler, et al. [53:134] and Cooper [36:77-82] have identified symptoms or warning signals to assist managers in determining whether a need exists to revise or replace the existing cost system.

Turney recommends several techniques for generating organizational interest in ABC [142:210-213]. He encourages the identification and development of ABC "champions" at all levels in the organization. The champions foster interest

and attempt to obtain additional endorsement from other departments or senior management. ABC advocates can also generate interest by exposing management to ABC seminars and materials or using benchmarking to demonstrate how other companies have benefitted from ABC.

Brausch [17:42-46] and Turney [142:213-218] identify several impediments an ABC implementation proposal must overcome before obtaining management approval. Brausch identifies three hurdles cost accounting management must overcome to effectively communicate the need for a new cost system. The hurdles include a perceived inadequacy of cost accounting as a discipline, proving the new system will do any better than the old system, and tremendous implementation costs. Brausch recommends the use of extensive communication, the marketing of an ABC system's advantages, and the use of a cost-benefit analysis to overcome the hurdles. Turney also identifies four management preconceptions or "myths" as barriers to ABC implementation [142:213]:

- ABC is too difficult to implement and use.
- Improving the existing system will do the job.
- We do not need more accurate product costs.
- Cost systems play a limited role in process improvement.

He advocates a variety of techniques for dispelling these preconceptions. The techniques consist of using a limited pilot program to demonstrate the methodology and impact,

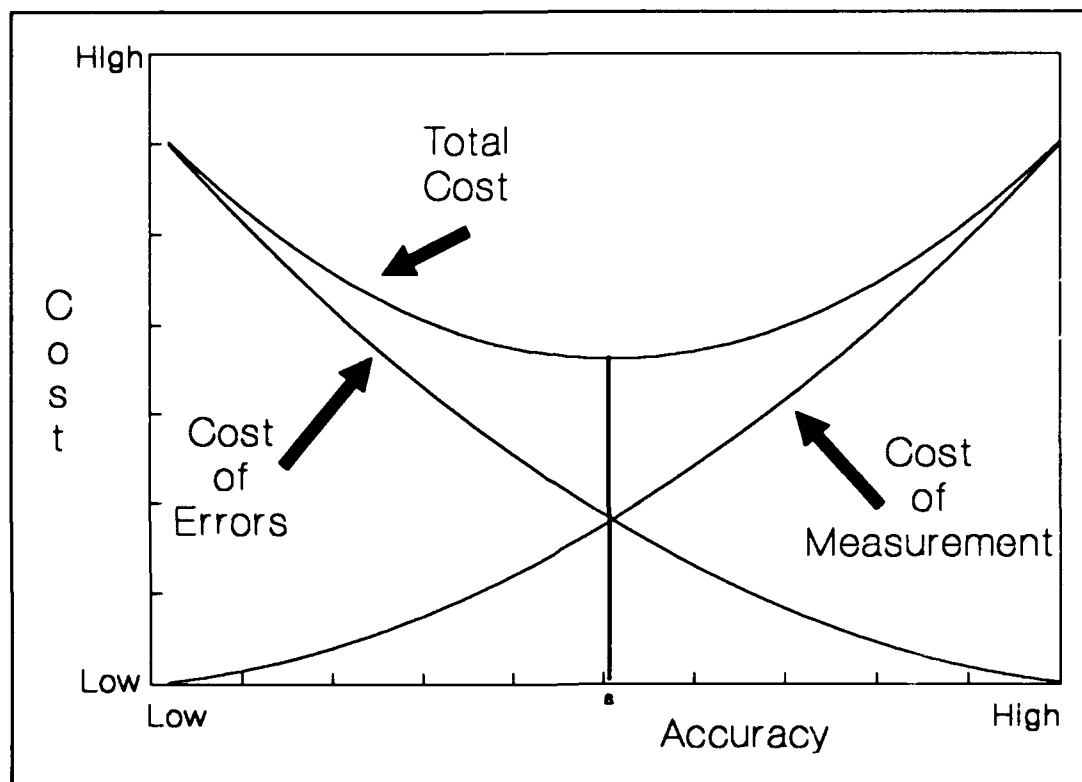
identifying how the current system can significantly miscost products, providing examples of how ABC's non-financial information can identify opportunities for process improvement [142:214-218].

Sharman [133:25] and Chaffman and Talbott [23:18] also recommend the consideration of a pilot ABC study. A pilot study can overcome the uncertainty regarding the complexity, time, and money required to develop an ABC system [133:25]. Brausch cites an Institute of Management Accountants study where 32 percent of responding manufacturing companies spent over \$100,000 to implement ABC [17:44]. Chaffman and Talbott caution ABC may not represent the best course of action for every company. The results of a pilot study would establish whether ABC produced significantly different or better results than the current system [23:17:18].

Cooper provides an in-depth discussion of how a firm can determine when a need exists for an ABC system. An organization can use three factors to justify the need for an ABC system: the sophistication of the information systems, the cost of errors, and the diversity of products. Cooper uses a cost trade-off analysis to determine the level of accuracy required:

The point at which the marginal cost of an improvement [in measurement] just equals the marginal benefits of the improvement defines the optimal cost system. A result of the trade off between the cost of measurement and the cost of errors is that the optimal cost system is not the most accurate cost system. The degree of

approximation (or distortion, depending on your point of view) in product costs depends on where the optimum occurs. If the optimum demands accuracy exceeding that reported by the best traditional cost system, then an activity-based system is required [32:42].



**Figure 6.** Optimal Cost System [32:42].

Three situations can shift the position of the optimal cost system and increase the demand for greater accuracy. A decrease in the cost of measurement, an increase in the cost of errors, and an increase in product diversity will cause the total cost curve to shift to the right and reflect a need for greater cost accuracy. Cooper explains how the situations could occur. The cost of measurement can fall

with the introduction of new information technology and the decreasing costs of the technology. The cost of errors can increase due to more intensive or focused competition or market deregulation. An increase in product diversity will cause a shift by increasing the distortion in product costs and thereby decreasing the cost accuracy reported by the existing system [32:43-44]. Cooper indicates an ABC system is justified

. . . whenever the costs of installing and operating such a system are more than offset by its long-term benefits (which although real, are difficult to quantify). This trade-off differs for every firm and depends on the three factors that affect the optimum system and the adequacy of the existing cost system [32:48].

#### Planning Stage

Turney suggests differences in company needs, size, complexity, types of activities and processes, technology, information systems, products, and customers will alter the type of ABC system selected. However, he contends the steps required for successfully planning an ABC system remain the same; however, the specific actions within each will vary. The eight common steps to most plans identified by Turney include [142:226]:

1. Formulate the objectives.
2. Describe the deliverables.
3. Set the scope.
4. Describe the organization structure.
5. Identify team membership.
6. Determine the training requirements.

7. Complete a project schedule.
8. Budget the costs of the project.

Brausch [17:45] and Sharman [133:25] also comment on the implementation planning stage. Brausch makes a strong argument for openly communicating the objectives of the cost management system throughout the organization and including representatives from any area touched by the cost system on the project team. Sharman also advocates representation from multiple areas, particularly accounting, engineering, and operations.

Cooper proposes a slightly different approach to implementation planning by suggesting that six design decisions occur before developing the plan and proceeding with implementation [29:33]:

1. Should the system be integrated with the existing system or should it be a stand alone system?
2. Should a formal design be approved before implementation?
3. Who should take "ownership" of the final system?
4. How precise should the system be?
5. Should the system report historical or future costs?
6. Should the initial design be complex or simple?

Cooper contends these six "predesign" choices can reduce the time required to implement the system and make it possible to avoid unnecessary precision or interfaces with other systems.



A major predesign choice identified by Kaplan centers on the use of multiple cost systems. Many firms recognize a need to change their cost systems, but efforts to redesign existing systems have proven disappointing. Kaplan proposes the revised cost systems have failed because their designers did not recognize the need to address three different functions: inventory valuation, operational control, and individual product cost measurement [85:61]. Kaplan argues

No single system can adequately answer the demands made by the diverse functions of cost systems. While companies can use one method to capture all their detailed transactions data, the processing of this information for diverse purposes and audiences demands separate, customized development. Companies that try to satisfy all the needs for cost information with a single system have discovered they can't perform important managerial functions adequately. Moreover, systems that work well for one company may fail in a different environment. Each company has to design methods that make sense for its particular products and processes.

#### Data Collection and Analysis

The data collection and analysis stage obtains the information required for designing an ABC system. The data includes information about resources, activities, cost objects, and the linkages between them [142:241]. Cooper suggests a two phase approach for data gathering. The first phase examines the direct material and labor standards. The second phase analyzes overhead and determines the activities driving overhead requirements [29:37].

The information gathered during this stage originates from a variety of sources. Turney identifies three primary sources of information as: (1) the accounting department to gain information regarding the cost of resources; (2) the people performing the work to determine the resources, cost drivers, and performance measures; and (3) the company's information systems can provide information regarding cost objects, performance measures, and activity drivers [142:241].

Turney indicates the different sources of information will require different collection techniques. He identifies five ways for collecting ABC information: observation, timekeeping systems, questionnaires, storyboards, and interviews. Interviewing represents the most commonly used, yet most time consuming approach. The two-way communications enable the interviewer to gather data about the activities while the manager learns more about ABC [142:257].

#### Design Stage

The design stage represents a critical stage within the implementation process. It determines the structure and adds intelligence to the ABC system [142:261]. ABC designers face the challenge of coming up with a system that gives managers not only accurate product costs but also

information about the cost of activities in a form which management can easily and correctly interpret [9:52].

Brimson, Turney, and Cooper advance procedures for designing an ABC system. The three approaches use Cooper's two stage allocation process as a foundation and focus on identifying the elements of the system: resources, activities, and cost drivers. The three approaches primarily differ in the level of detail.

Brimson proposes a seven step process for an ABC system [18:58-59]:

1. Activity analysis
2. Life-cycle classification
3. Determination of activity cost
4. Identification of performance measures
5. Determination of the cost of business processes
6. Tracing of cost to reporting objective
7. Calculation of activity cost

Turney uses a six step process [142:261]:

1. Identifying activities
2. Reconstructing the general ledger
3. Creating activity centers
4. Defining resource drivers
5. Determining attributes
6. Selecting activity drivers

Cooper developed a five stage process [30:78]:

1. Aggregate actions into activities
2. Report the cost of activities
3. Identify activity centers
4. Select the first-stage drivers
5. Select second-stage drivers

A review of these approaches suggests five features common to each approach: activity analysis, developing resource categories, determining cost drivers, determining activity costs, and tracing costs to the cost object.

### Activity Analysis

The three approaches have a common first step, the analysis and identification of activities. Turney refers to the identification and definition of activities as functional decomposition [142:262]. The activity analysis decomposes a large, complex organization into understandable and manageable activities. Brimson contends that the management of activities gives an organization better insight into how resources are employed and whether the activity contributes to the achievement of corporate objectives [18:60].

Turney provides four rules for identifying activities [142:262]:

1. Match the detail to the purpose of the model.
2. Use macro activities to balance conflicting objectives.
3. Combine insignificant items.
4. Describe activities clearly and consistently.

The first rule ensures the model does not have too much detail but maintains sufficient complexity to adequately model the system. Turney's second rule introduces the concept of macro activities—the aggregation of related

activities. A company may want to use one activity to model multiple activities at the same level, with the same activity driver, and with a common purpose. The combination of insignificant activities into macro activities reduces the clutter in the model and enables management to concentrate on the key, expensive activities. Consistent, concise activity definitions streamline the activity mapping process and promote understanding of the model [142:263-267].

Cooper and Brimson also recommend aggregating or rationalizing activities to preclude an excessive level of detail. However, they caution the ABC modeler to avoid oversimplification. Brimson suggests ". . . an excessively simple system does not provide the level of detail necessary to properly account for activity cost behavior" [18:93]. Cooper warns ". . . as more and more actions are aggregated into an activity, the ability of a cost driver to accurately trace the resources consumed by the products decreases" [30:78].

Brimson includes activity mapping as part of the activity analysis. "An activity map identifies the relationships between functions, business processes, and activities" [18:96]. He contends the activity map represents the first step in analyzing alternative business processes and the activities required to perform a function. Morrow and Hazell suggest "The activity map gives a

horizontal view of the business which is not distorted by the organisational boundaries" [111:38]. Managers can explore options to achieve simplicity and cost effectiveness across the entire process.

#### Developing Resource Categories

The second design step concentrates on identifying all of the significant resources required to perform an activity. Resources consist of the people, machines, travel, supplies, computer systems, and other resources commonly expressed as cost elements within a chart of accounts [18:60]. Turney recommends starting with the general ledger to obtain the financial information about company resources. The general ledger provides, in one place, a summary of all important financial data about the company [142:267]. Turney makes several cautions regarding general ledger data. He has found the information does not easily translate into activity costs and frequently has costs organized around expenditure rather than process [142:268].

### Determining Cost Drivers

The ABC model contains two sets of cost drivers. The resource drivers define the consumption of resources by activities [142:272], and activity drivers capture the demands placed on activities by cost objects [142:281].

Resource drivers link resources to activities by taking costs from the general ledger or resource category and assigning the costs to activities. The resource drivers represent direct consumption of a resource by the activities. The part of each resource assigned to an activity becomes a cost element placed within the cost pool for an activity [142:101-102].

Activity drivers represent the factors creating cost in an organization [18:121]. The activity drivers measure the consumption of activity and trace the cost to a cost object [142:54]. A strong correlation must exist between the activity driver and the activity consumed to prevent cost distortion. As a result, Turney [142:57] and Cooper and Kaplan [41:132] developed a hierarchy of activities and activity drivers to reflect the different levels of relationships existing at the unit, batch, product, customer, process, or sustaining levels.

Cost drivers may require several key ABC design decisions. The project team may encounter resources and activities where the tracing of costs may prove infeasible, and an arbitrary allocation scheme may become necessary for

allocating the resource or activity costs to the cost object [142:274-276] [18:119]. Cooper and Kaplan suggest that some costs, such as facility-level costs, should be kept at the plant level and not assigned to products [41:133]. The project team must also determine how to assign fixed costs such as depreciation. Turney recommends tracing resources and activities on a consumed basis rather than on a time period basis. He argues ABC does not need to follow generally accepted accounting principles. ABC has the primary purpose of business improvement, not financial reporting [142:269-270].

Cooper also identifies the number of cost [activity] drivers as a crucial design decision. He contends several factors will require the use of multiple cost drivers including: the desired accuracy of product costs, the degree of product diversity, the relative cost of different activities, the degree of volume diversity, and the use of imperfectly correlated cost drivers [33:45]. He also identifies three factors affecting the selection of cost drivers used in an ABC model [33:45]:

- Cost of measuring the cost driver. The lower the cost, the more likely the cost driver will be selected.
- Correlation of the selected cost driver to the actual consumption of the activity. The higher the correlation, the more likely the cost driver should be used.
- Behavior induced by use of the cost driver. The more desirable the behavior induced by using the driver, the more likely the driver is to be selected.



### Determining Activity Costs

The activity cost includes all of the resources employed to perform an activity. Brimson indicates the ABC model determines activity costs by [18:60-61]:

. . .tracing the cost of all significant resources to perform an activity. . . .Activity cost is expressed in terms of a measure of activity volume by which the costs of a given process vary most directly. For example, the cost of scheduling production orders may be expressed as a cost per production order.

The activity cost is the sum of the resource cost elements in the cost pool divided by the number of times the activity is performed [142:98].

### Tracing Costs to the Cost Object

The final feature of the ABC model design assigns activity costs to the cost object. Cooper indicates "The reported cost of a product in an ABC system equals the sum of the costs of all activities that must be performed to manufacture and deliver the product" [28:87]. The cost drivers directly impact the cost by determining the volume and types of activities actually traced to the cost object. Turney suggests the "Cost objects are costed accurately when the activities drivers measure the use of activities directly or correlate closely with the use" [142:109].

### Operational Stage

The final stage of the implementation process results in an operational ABC system. Turney indicates the final stage requires two additional management actions. First, management must plan for the use of ABC information. Follow-on actions must ensure adequate user training, timely and understandable reports, and updates to the model as changes occur in the organization. Second, the organization must manage the process of change. ABC will identify many opportunities for improvement. Management must identify the improvement goals, assign responsibility, provide user support, and seek timely feedback [142:287-298].

Cooper and Kaplan also support the need for managing change [41:134-135]:

ABC analysis highlights for managers where their action will likely have the greatest impact on profits. Managers should take two types of actions after an ABC analysis. First, they should attempt to reprice products: raise prices for products that make heavy demands on support resources and lower prices to more competitive levels for the high-volume products that had been subsidizing the others. . . .Second, and more important, managers should search for ways to reduce resource consumption.

### Summary

Section Four reviewed the literature discussing the implementation and design of an ABC system. The review included a discussion of the five steps commonly used during ABC implementation. Sections Five and Six review the

literature specifically addressing ABC applications with logistics and the supply chain.

### Section Five

#### Cost Accounting Applications Within Logistics

The cost accounting applications within logistics functions is examined in Section Five. The section begins with a review of the traditional methods of logistics cost analysis. The review continues by examining three studies of logistics cost accounting and control jointly conducted by the National Association of Accountants and the National Council of Physical Distribution Management. The review of cost accounting applications in logistics concludes by examining recent ABC applications within logistics functions.

#### Traditional Methods of Logistics Cost Analysis

Lewis and Erickson provide a definition and an outline of the traditional methods of distribution [logistics] cost analysis [100:3-6]. They refer to the traditional method as a body of knowledge produced by academicians and practitioners such as Sevin, Heckert, Miner, Longman, and Schiff. The outline proposed by Lewis and Erickson follows the types of analyses initially recommended by Heckert [69:19] and later by Heckert and Miner [70:17]. Heckert's approach analyzed distribution costs:

1. By the nature of cost items or object of expenditure
2. By functions or functional operations performed
3. By the manner in which the distribution effort is applied [69:19]

#### Analysis by Nature of Cost Items

Heckert and Miner indicate the first analysis made of distribution costs usually occurs by nature of the cost item or the object of expenditure [70:17]. Salaries, advertising, supplies, taxes, etc., would receive separate cost classifications and generally would be made a part of the ledger accounts. Lewis and Erickson suggest the main value of natural analysis lies in the ability to analyze ratios and to consider questions posed by the analysis [100:4]. Heckert and Miner caution

Analysis by nature of cost items is sufficient only when there are no problems as to the efficiency of particular distribution operations; or as to what territories to cover, what commodities to sell, what sales methods to employ, etc. [70:17]

They also emphasize this type of analysis will only ascertain the cost of the distribution function as a whole. The analysis will not provide the costs of performing specific operations or securing particular results [70:18]. Sevin appears to share their view:

But a natural-expense classification does not permit an allocation of the indirect marketing expenses to individual products, customers, and other sales segments nor does it provide an adequate basis for measuring efficiency and for controlling expenses. It is thus usually necessary to apportion many natural-expense items as they may appear in the ordinary accounting records among several functional-cost groups, since they are related to more than one functional activity [128:17].

### Analysis by Functions

Analyzing distribution costs by "function" provides greater management value for cost control [100:5] [70:18]. Heckert and Miner define a function as "a major distribution activity for which costs are assembled" [70:18]. The cost assignment to functions ". . . opens the way for the establishment of standard unit costs and the control of the costs by the applications of such standards" [70:19].

The functional analysis approach requires four steps to permit a comparison between standard and functional costs [70:18-19]. The first step outlines the different functions and functional operations performed in the organization. The second step classifies the individual cost items by functional groupings. The third step establishes units of measurement of functional service. The fourth step divides an operation's total cost by the units of service performed to arrive at a unit operation cost.

Lewis and Erickson summarize the functional analysis:

It is then necessary to set up units of measurement which should reflect the source or sources of variance in the functional cost. Then, unit operation costs are established for the particular activity. And, finally, both the total cost and the unit costs for each activity are compared with standards of performance, variances noted and, where appropriate, an attempt made to explain the variances [100:5].

The assignment of natural accounts to functions raises the issue regarding the extent of cost allocation [100:5]. The firm must determine whether to allocate any of its indirect costs. However, Heckert and Miner argue [70:22]

On the premise, then, that functional analysis should be designed to measure the cost of activities for which given individuals are responsible, only those variable costs which are controllable should be included in the analysis.

Sevin also addresses the allocation of fixed costs in measuring marketing productivity and makes the following recommendation [128:20]:

It is useful to allocate portions of fixed marketing costs to specific segments of the business because there are nearly always alternative marketing uses for such "pieces" of fixed costs. If it is discovered, for example, that a certain fixed marketing costs earns only  $x$  dollars in its present use, it may be possible to shift this marketing capacity to an alternative use that would bring in  $2x$  dollars.

### Analysis by Application

Heckert and Miner advocate the analysis by application to provide direction for the distribution effort. They contend analysis by natural account or by function can prove valuable, but distribution effort, even though efficiently run, will remain unproductive unless given proper direction [70:23-24].

Sevin summarizes the approach as follows [128:12-16]:

1. The marketing expenditures of a particular business which are usually accounted for on a "natural" expense basis, are reclassified into functional-cost" groups. These functional-cost groups bring together all the costs associated with each marketing activity, i.e., marketing function, performed by that company.
2. The functional-cost groups are "allocated" to products, customers, territories, and other segments of sales on the basis of measurable factors. These measurable factors or bases of allocation are product, customer, and territory characteristics which bear a "causative" relationship to the total amounts of the functional-cost groups.

The analysis by manner of application also must address several key issues. Lewis and Erickson indicate that the analysis must determine the extent of cost allocation and that another major decision concerns ". . . whether the final analysis will report a net profit or contribution margin [100:6]. The approach also must determine an appropriate basis of cost allocation. Sevin discusses the method of identifying an allocation basis as follows [128:18]:

Another way of stating this allocation method is to say that the procedure is to determine, for each functional-cost group, the factor which "controls" it, tending to increase or decrease it. As used here, the term control is meant to convey the concept that the total level of the functional cost is determined by the total level of the control factor. In other words, there is a "cause-and-effect" relationship between the factor used as a basis of allocation and the dollar level of the corresponding functional cost group.

#### Limitations of The Traditional Methods of Logistics Cost Analysis

The traditional methods of logistics cost analysis contain several limitations which have effected their practical application. The most important single limitation centers on the nature of the traditional procedure [100:6]:

Herein lies the source of major limitations to distribution cost analysis. Where production cost analysis starts with identifying the multiple cost centers representing the sources of costs and works toward aggregate costs, distribution cost analysis starts with the aggregate and works backwards toward the source. This reallocation of aggregate costs results in a loss of accuracy in determining distribution costs variations at their source.

Organizational difficulties have impacted distribution's [logistics'] ability to account and control costs [122:6]. Many physical distribution activities remained outside the control of physical distribution personnel, and the application of traditional accounting methods to these functional cost centers has generally hidden true distribution costs.



Information requirements frequently posed a major limitation to the development of distribution costing systems. The in-place systems did not provide meaningful accounting data [156:33] or the capability to manipulate the vast amount of data in an economic way [122:7]. Data collection required extensive, time-consuming and expensive research for the individual firms. The results would also require continual adaptation as territories, customers, or products changed [154:14].

Generally Accepted Accounting Principles (GAAP) also limited the development of distribution costing systems.

. . . GAAP required the current expensing of distribution costs — a requirement at odds with the notion of assigning distribution costs to products. An integrated distribution system would require regular aggregation and disaggregation of costs and tracking the accruals and deferrals at regular intervals...Although not an insurmountable problem for the firm determined to invest in the system, it is easy to imagine the dismay of management facing such a prodigious task for the first time [154:14].

#### Previous Research

The National Association of Accountants (NAA) and the National Council of Physical Distribution Management (NCPDM) [later renamed the Council of Logistics Management] have sponsored three studies of the accounting and control of logistics costs. The first study, conducted in 1972, evaluated the current state of the art for reporting and controlling of logistics costs and drew several conclusions

regarding the suitability of cost accounting systems to support logistics decision-making. The second and third studies, performed in 1983 and 1985 respectively, provided a more detailed analysis of the state of the art cost accounting practices within transportation and warehousing and provided guidelines for improving the financial information systems required for logistics decision-making in the 1980s.

Accounting and Control in  
Physical Distribution Management (1972)

The first joint NAA/NCPDM study focused on examining the state of the art cost information systems employed by large corporations. The sponsoring organizations sought to advance physical distribution management by investigating the approaches and methods used in developing and reporting physical distribution cost information. The investigation concentrated on providing insight into an area lacking extended empirical research. Schiff indicates:

It is the purpose of this study to examine and evaluate the state of the art in reporting for control and decision making in P.D. [Physical Distribution] and in other functional areas of business where P.D. costs are deemed relevant. As a first step decision areas affected by P.D. will be catalogued. The organization and positioning of P.D. will be examined followed by a detailing of the reporting systems in use. Finally, the suitability of the output of the system and its ability to meet management needs will be evaluated [127:1-2].

The study's conclusions identified how accounting practices affected physical distribution information and management. The areas relevant to the reporting and costing of logistics include the financial reporting of physical distribution costs, the allocation of costs for profit reporting, tools for controlling costs, and the use of physical distribution costs in decision-making.

**Reporting of Physical Distribution Costs.** The study derived three conclusions regarding the reporting of logistics costs. First, Schiff expressed considerable concern regarding the classification of logistics costs for internal use:

What is of primary concern in this study is the suitability of P.D. cost reporting for internal use, and failure to identify these costs and classify them as operating expenses can only suggest that management and the accountants do not think these costs are important enough to warrant the attention and concern of the receiver of the report or that they can be influenced by the manager to whom the report is addressed. It is difficult to find a logical basis for this position. The costs are identified and assembled in accounts and in all cases they are of significant dollar value to warrant identification. It would take a minimum of effort and re-education to alter the classification wherein freight and other distribution costs would be identified as operating expenses and thus more closely relate responsibility with reported results [127:1-8].

Second, the report noted inconsistencies in the matching of costs and revenues. Several firms expensed warehousing and freight as incurred. The practice seriously distorted the

costs used in measuring physical distribution performance—costs incurred did not properly align with the realization of revenues. Schiff argued:

If profit reporting is to be used at all, it must at least reflect resources consumed (costs) in connection with related revenues produced within a time period [127:1-8].

Third, the study found many firms did not include an imputed interest cost on inventories. Schiff suggested financial reports could provide a more realistic report on profits by deducting imputed interest as an expense to reflect the cost of capital committed to inventories [127:1-8].

Cost Allocation for Profit Reporting. The study found many of the large corporations had implemented a wide range of techniques for allocating physical distribution costs [127:1-9]. The more complex techniques incorporated a two step process of allocating natural expenses to physical distribution functions and using a base, such as invoices or cases, for allocating functional costs to products or customers. The process encountered problems when allocating common costs for profit or responsibility reporting. Schiff proposed that firms should not allocate common costs to profit centers. Individual managers could not exert control over the common costs, and the allocation of common costs made profit center reporting less relevant [127:1-10].

Cost Control Tools. The tools used for controlling physical distribution costs closely paralleled the financial tools used in controlling manufacturing operations [127:1-10]. The report suggests many of the same techniques used in manufacturing, fixed budgets, flexible budgets, and standard costs, could apply within physical distribution.

Physical Distribution Costs in Decision-Making. Schiff argued that the problem regarding the use of physical distribution costs in marketing decision-making no longer resulted from information availability. Firms possessed the capability to abstract physical distribution costs from existing financial systems [127:1-11]. Instead, he contended that the problem stemmed from management perceptions:

The problem is not one of information availability or the ability to derive from current cost systems the relevant costs for decision-making. The underlying point is that in the companies studied Marketing does not generally use P.D. information and there is no current motivation which requires such use. It is as if communication between two parties is undertaken. The sender (P.D.) is quite able and willing to communicate. The receiver (Marketing) is not inclined to listen and the current reward systems serves to encourage indifference on the part of the receiver [127:1-13].

Transportation Accounting and  
Control (1983)

NAA and NCPDM commissioned this study to develop guidelines for improving transportation accounting and control. The transportation industry had already undergone many rapid and intense changes during the early 1980s resulting from an uncertain energy supply and transportation deregulation. The study concentrated on identifying opportunities within industry practice to improve the accounting and control of transportation.

The study had four specific objectives [55:xi]:

- Describe the needs of financial and distribution managers for improved timeliness and accuracy of transportation cost information.
- Assess state-of-the-art of current practices in applying methods and techniques for transportation accounting, cost control, and information management.
- Describe guidelines for important issues related to transportation costing, planning and budgeting, responsibility accounting, performance reporting, standards, cost allocation, transfer pricing, and internal controls.
- Suggest guidelines for designing or improving transportation information systems to support decision-making.

The study of transportation industry practice identified four major findings. The study team found a wide variety in the sophistication and comprehensiveness of accounting practices within the transportation industry. Most transportation accounting systems lacked information needed to support management. Organization and structure had a major impact on accounting practices within a firm.

Some firms had implemented what the team considered to be modern accounting systems [55:xii].

#### Warehouse Accounting and Control (1985)

The third NAA/NCPDM study examined the accounting and control of warehousing costs. The warehousing study had a broader purpose than the transportation study by also identifying how the use of improved information affected warehouse management.

The study had three key objectives: to describe the most common warehouse problems and their cost implications; to assess the current state of practice in accounting and control for warehousing activities; and to suggest guidelines for the application of management accounting techniques and for designing or improving warehouse information systems [56:19].

The report also took a more practical approach for discussing cost accounting techniques for warehousing. Practical examples of the applications of management accounting techniques to warehousing problems comprise most of the report's results. However, the report found missing or inappropriate cost information continued to hamper efforts to improve distribution management [56:17]. The report also indicates advancements such as just-in-time inventories had made timely and accurate cost information more critical [56:5-16].

### ABC Applications Within Logistics

Cooper points out that practical ABC applications have emerged only within the last ten years [29:33]. The focus of these applications has centered on manufacturing processes rather than logistics and other service industries [120:9] [124:4]. However, certain leading companies have begun to concentrate on logistics due to the important role played by customer service in a company's strategy [120:9]. The recent development of ABC and even more recent application to logistics and the service industry as a whole has resulted in even less literature concentrating on ABC applications within logistics.

Rotch [124] indicates service enterprises can benefit from ABC implementation. Service enterprises confront many of the same conditions that make manufacturing enterprises good ABC candidates: diversity of resource consumption, and product and resource consumption not correlated with traditional volume-based allocation measures. However, the service industry has several distinctive characteristics which make implementation more difficult [124:8]:

- Output is harder to define;
- Activity in response to service requests may be less predictable; and
- Joint capacity represents a high portion of total cost and is difficult to link to output-related activities.



Lewis contends physical distribution represents one of the most effective areas for applying ABC, and "Activity-based costing techniques have been and should continue to be applied to marketing costs to assist companies in decision making" [101:38]. He argues that ABC principles do apply to the tracing of marketing [physical distribution] costs to product lines and territories. Physical distribution should receive greater emphasis since it accounts for more than 50 percent of the total costs in many product lines and approximately 20 percent of the U.S. Gross National Product [101:33]. Lewis also contends that 20 years ago marketing managers of several hundred U.S. corporations recommended an activity-based approach for physical distribution; however, the accounting profession has largely ignored the recommendations of practitioners and overlooked the similarity between the cost characteristics of physical distribution and production [101:38].

Roth and Sims also advocate using ABC in a service environment and particularly in warehousing and distribution [126:42]. They develop a warehousing example to describe how a distribution firm could implement ABC to trace costs and improve efficiency. Distribution managers can use the information obtained from an ABC system to help reduce costs by decreasing the number of times an activity is performed and by reducing the cost per unit of activity [126:45].

Quillian presents the results of applying ABC to an electrical products manufacturer. The company used a combination of total cost management (TCM) and ABC to effect a reduction in order fulfillment costs and order cycle time. Quillian found that the company had grouped non-manufacturing costs together and allocated costs to each product on the basis of cases produced. Management used ABC to identify how the logistics processes effected the company's key customer logistics strategy and to determine the costs of the activities. ABC enabled management to determine the costs of providing a 100 percent shipment accuracy strategy and to identify opportunities where new technology could eliminate activities and cost [120:9-14].

#### Summary

The available literature describing ABC applications within logistics was covered in Section Five. The recent emergence of ABC and even more recent application of ABC to logistics has produced only a limited discussion of how ABC may effect logistics. The potential ABC applications within the supply chain are examined in Section Six.

## Section Six

### ABC Applications Within the Supply Chain

Porter [119] and Shank and Govindarajan [130] recommend companies adopt value chain analysis to obtain a competitive advantage through cost reduction or service differentiation. The authors contend that opportunities exist external to the firm for achieving a competitive advantage. Porter suggests "Vertical linkages are frequently overlooked, because identifying them requires a sophisticated understanding of supplier and channel value chains" [119:76]. This section of the literature review examines the application of ABC techniques to the supply chain.

Porter advocates value chain analysis as a technique to gain a competitive advantage. The approach requires an organization to identify and aggregate activities, determine cost drivers, and assign overhead and asset costs to the value activities [119:70]. He suggests an organization can achieve a competitive advantage by performing value activities at a lower cost than its competitors [119:64] or by exploiting the linkages between value activities [119:75-76].

Porter contends that firms can also exploit the linkages within the value chain of suppliers and channels to achieve a competitive advantage. A firm can identify cost reduction opportunities by examining how supplier or channel

behavior affects the cost of each of its activities and vice versa.

For example, the location of a channel's warehouses and the channel's material handling technology can influence a firm's outbound logistical and packaging cost. Similarly, sales or promotional activities of channels may reduce a firm's sales cost [119:77].

Exploitation of the linkages may force the channel members to reevaluate the distribution of costs and savings within the channel. Porter notes:

. . .channel linkages may allow both the firm and its channels to lower cost. However, exploiting channel linkages may require the channel to raise cost for a more than offsetting reduction in the firm's cost [119:77].

The ability to exploit vertical linkages provides the opportunity for joint optimization of the value chain; however, the participating firms must cooperate to overcome potential impediments.

The seeking out and pursuing of such opportunities will require careful study of supplier and channel value chains as well as the determination to overcome suspicion, greed, and other barriers to joint action. A firm must be prepared to share the gains of linkages with suppliers and channels in order to ensure that they can be achieved [119:103].

Shank and Govindarajan provide a framework for constructing and analyzing value [supply] chains. The framework consists of three steps. The first step identifies and disaggregates the value chain into strategic

activities. Costs, assets, and revenues are then assigned to the activities. The second step diagnoses the cost drivers that explain variations in costs in each value activity. The third step develops a competitive advantage by either controlling the cost drivers better than competitors or by reconfiguring the supply chain [130:11-13].

Shank and Govindarajan contend that a firm can use the perspective achieved through the value chain framework to derive the following insights:

- A knowledge of the full, linked set of value activities of which the firm and its competitors are a part.
- Critical strategic decisions (e.g., make-or-buy or forward or backward integration) become clearer.
- Supplier power by calculating the percentage of total profits that can be attributed to suppliers.
- How a firm's product fits into the buyer's value chain.
- A sophisticated understanding of the drivers of costs, revenues, and assets at each value activity and the interdependencies between value activities [130:21].

#### Summary

A review of the literature discussing the changes in the business environment and their implications for cost accounting, the ABC concept, the differences between ABC and traditional cost accounting, and ABC applications within logistics and the supply channel was presented in this chapter. The literature supports the research's objectives

by suggesting how more accurate product costs and the use of nonfinancial information may effect management decision-making; alter the reporting of product, customer, or channel costs; and change the cost trade-offs and performance evaluations between organizations internal and external to the firm. The review also outlined several approaches for implementing and designing an ABC system. A methodology for exploring how the cost, internal and external relationship, and implementation issues identified in the literature specifically apply to logistics decision-making and ABC implementation within a logistics setting is developed in Chapter Three.

## CHAPTER III

### METHODOLOGY

#### Introduction

Chapter Three contains the methodology employed during the research. The chapter begins with an overview of the methodology and continues with a description of the research design. Subsequent sections include the process used for verifying variable classifications, the research questions, the research propositions, and the steps required for implementing the research design.

The research consisted of eleven exploratory case studies of logistics organizations in various stages of implementing an ABC system. The case studies consisted of structured, in-depth personal interviews with key decision makers, logistics managers, implementation personnel, and other personnel actively involved in ABC planning, approval, design, or implementation.

Analysis of these interviews determined the effect of ABC on (1) logistics decision-making, (2) the reporting of logistics costs, (3) design and implementation process within logistics, and (4) the logistics function's

relationships with other functions within the organization and with other organizations in the supply chain.

The research followed the case study method to obtain information from organizations implementing an ABC system. The case study approach is best suited to situations with limited knowledge or previous research and requiring an in depth investigation [160:89] [46:101]. The case study approach was appropriate due to the current state of research of ABC use within logistics. ABC applications have primarily focused on manufacturing applications, and applications within logistics have received only limited attention [126:42] [120:34]. This type of approach also has the advantages of studying an entire organization in depth and using follow-on questions to probe for additional depth or clarification. The highly focused attention of the case studies provided an opportunity to study the order of events and concentrate on identifying the relationships among functions, individuals, or entities [160:101].

The case studies focused on examining how activity-based costing has effected the relationships between the logistics function and other internal functions and other external organizations. Quillian [120:9-14] suggests that ABC implementation will affect internal relationships by enabling firms to overcome the "functional silo syndrome." Firms will use ABC to examine how to improve process efficiencies across internal organizational boundaries.



Shank and Govindarajan [130:5-21] suggest that coupling ABC with value chain analysis will alter the relationships between organizations in the supply chain. Value chain analysis will identify opportunities to increase channel efficiency and reduce the total cost of the product.

Purposive sampling was used to select firms for an in depth analysis of ABC implementation and its impact on logistics relationships. Purposive sampling, a nonprobability sampling technique, permitted the selection and examination of logistics organizations with leading edge business practices. The limited number of logistics organizations falling into this category, with an even smaller number having implemented ABC, further justified the use of purposive sampling. Firms were selected based on a pretest of interest in ABC using the instrument contained in Appendix A and recommendations of knowledgeable logistics professionals and researchers. The research used the following criteria to determine suitability of an organization:

1. The organization had to perform logistics functions.
2. The organization had to be currently active in one of the five ABC implementation stages.
3. The organization had to lie within a supply chain, i.e., the supply chain could not be vertically integrated within one firm.

The ABC focal point within each organization received a telephone follow-up to the pretest requesting information regarding the research criteria. The questions asked during the telephone contact determined if the organization met the research criteria. Appendix B contains the question set used for this purpose.

The case studies involved in depth personal interviews with several members of each firm. Interviews included personnel within logistics, finance and accounting, or the ABC implementation team. Individuals identified for the interviews received an advance copy of the interview protocol as shown in Appendix C. The advance copy enabled the individuals to prepare for the interview or obtain background material where appropriate. The cover letter contained the researcher's name and telephone number allowing the individual to contact the researcher to clarify any questions before the interview.

The interviews occurred on site and consisted of the questions included the interview protocol. The questions explored several areas regarding ABC implementation: (1) general background of the organization; (2) the implementation process; (3) information regarding the previous cost accounting system used for logistics; (4) the ABC system currently in use or under development; (5) the performance measurement system; and (6) logistics attitudes towards ABC implementation.

Interview responses supported an analysis of the effect of ABC on the logistics organization. An analysis of logistics cost reporting and performance measurements provided indications of how management has attempted to influence behavior in the logistics organization and the role logistics plays in determining the total cost of a product. The effect of ABC on the internal and external relationships of the logistics organization were examined by reviewing how the firm performs cost trade-off analyses, the cost drivers used in decision-making, and interactions between logistics and other organizations to effect cost reduction. The research used the response data and subsequent analyses to describe the ABC design and implementation process used in other logistics organizations and to analyze the approaches used for performing a supply chain analysis of logistics costs.

### Design of the Research

#### Research Variables

The research focused on examining the impact of ABC implementation on the logistics organization and logistics decision-making. The available literature examining ABC has primarily concentrated on the design and implementation issues; however, many other variables may influence the level of sophistication, cost reporting, and decision-making applications of ABC. The research used the following

variables to examine ABC applications within logistics: effect on logistics decision-making and performance measurement, size of the firm, stage of ABC implementation, and centralization of the logistics function.

#### Definition of Variables

The variable of "effect on logistics decision-making and performance measurement" was measured based on changes in logistics cost trade-offs, relationships, contacts, and managers' perceptions and attitudes. This variable was designed to reflect areas of change which play an instrumental role in logistics decision-making. The components of the research variable observed during the research are included in Table 2.

TABLE 2  
 DEFINITION OF "EFFECT ON LOGISTICS DECISION-MAKING  
 AND PERFORMANCE MEASUREMENT" VARIABLE

COMPONENT	DETERMINED BY:
Logistics costs traced to the cost object	Managers' perceptions of ability to change  Reported changes in ABC product or service costs
Logistics performance measures	Implementation of activity-based performance measures  Activity-based performance measures included in evaluation system  TQM or continuous improvement goals based on ABC or ABM data
Logistics decision-making	Reported visibility of logistics costs  Reported changes in logistics cost trade-offs between functions  Benefits reported by logistics managers
Internal relationships	Volume of contacts or meetings reported  Coordination and sharing of ABC or ABM data  Reported changes in internal cost trade-offs
External relationships	Volume of contacts or meetings reported  Coordination and sharing of ABC data  Evaluation and selection of channel members using ABC data

The variable, "size of the firm," assigned participating organizations into two categories: large or small. Table 3 defines the two categories. The variable was measured based on the annual gross revenue reported by the organization. The variable was used to detect whether the size of the organization effected the ABC implementation process, altered the reporting of logistics costs, and affected the complexity of the ABC system. Existing ABC literature has not addressed how the size of an organization impacts ABC implementation and design.

TABLE 3  
DEFINITION OF "SIZE OF ORGANIZATION" VARIABLE

FACTOR	DEFINED BY:
Small	A logistics organization supporting a firm or government agency with gross revenues less than \$1 billion.
Large	A logistics organization supporting a firm or government agency with gross revenues exceeding \$1 billion.

The variable, "stage of ABC implementation," consisted of five classifications or categories. The variable was compared to the approaches used by the case study organizations to detect differences in implementation processes or procedures, times, benefits, and impediments.

TABLE 4  
DEFINITION OF "CLASSIFICATION OF ABC  
IMPLEMENTATION STAGES" VARIABLE

STAGE	DEFINITION
Problem Definition	Recognition of ABC as a viable approach. Generating interest for ABC Removing barriers to acceptance. Obtain management approval to proceed with implementation.
Planning	Formulate objectives. Set scope of project. Determine manpower, required actions, and funding requirements. Identify requirement for outside assistance. Finalize schedule, project budget, project team composition.
Data Collection and Analysis	Obtains the information required for designing an ABC system. Activity analysis of major processes performed. Resources, cost drivers, and cost objects identified. Existing cost system surveyed for potential sources of data. Interviews and surveys used to gather information regarding activities and cost drivers.
Design	Determines structure and adds intelligence to the ABC system. Design stage finalizes five major features of the ABC system: activity analysis, development of resource categories, determination of activity costs, determination of cost drivers, and tracing costs to the cost object.
Operational	An operational ABC system in place. Follow-on actions ensure adequate training, timely and understandable reports, and model updates. Management acts on opportunities identified by ABC.

The "organization of the logistics function" variable was used to categorize the participating firms by their organizational structure. The variable was used to identify whether the firm had centralized or decentralized logistics management and was also used to analyze whether centralization impacted how the ABC system reported logistics costs, the sophistication or complexity of the ABC system, length of implementation, and application of the ABC system to logistics decision-making.

TABLE 5  
DEFINITION OF "ORGANIZATION OF LOGISTICS FUNCTION" VARIABLE

FACTOR	DEFINED BY:
Decentralized logistics organization	Management, planning, and execution of logistics functions occurred at multiple locations below the corporate headquarters level.
Centralized logistics organization	Management, planning, and execution of logistics functions occurred at the corporate headquarters level or a single department.

The variables used in this research were arranged in a two by two matrix design as demonstrated in Table 6.



TABLE 6  
RESEARCH MATRIX

Organization	Size	
	Small	Large
Centralized	2	4
Decentralized	1	4

Verification of Variable Classification

The research verified variable classifications for size of the organization, stage of ABC implementation, and organization of the logistics function were made through information furnished by the organizations. Initial telephone contacts with the participating organizations obtained information regarding the size of the firm, the current status of ABC implementation, and the planning, execution, and management of its logistics functions. The interview protocol performed during the field visit confirmed the responses obtained during the initial telephone contacts.

"Size of the organization" and "organization of the logistics function" were obtained by examining annual reports, organization charts, and the reporting structure and from interviews with multiple respondents within each organization.

Verification of the variable, "stage of ABC implementation," followed a two step procedure. The first step consisted of contacting the points of contact for ABC within each organization. The individuals were provided implementation stage definitions as shown in Table 4 and were initially interviewed by telephone to identify the current implementation stage for their firms. The actions described in the Table 4 definitions determined the stage of implementation. The individuals also were requested to thoroughly describe the ABC implementation process to date and the current status of their ABC effort. The information obtained from the point of contacts was be used to assign the organizations to one of the five implementation stages.

The research verified the initial stage assignment by comparing the point of contacts' responses with the results obtained during on-site visits. The second verification step reviewed all of the information obtained from a company to make a final determination regarding the implementation stage. The stage assigned by the researcher did not differ from the stages identified by the participating organizations; however, the respondents sometimes used different titles based on their training or source of ABC information.

### Research Questions

The research had several goals based on the current state of empirical research of activity-based costing and its effect on logistics relationships within and external to the organization. The first objective was to ascertain whether ABC has effected logistics decision-making and performance measurement. The second objective was to determine whether ABC has changed the reporting of logistics costs. The third objective was to determine how ABC has changed the relationships between logistics and other functions within the organization. The fourth objective was to determine how ABC has effected the relationships of the case study organizations with other organizations or firms in the supply chain. The fifth objective was to examine how the logistics functions designed and implemented ABC and to develop general guidelines for implementing an ABC system with logistics. The sixth objective was to generate additional propositions for future research.

### Research Propositions

The research used several research propositions to test support for the research objectives. The number of case studies and use of purposive sampling did not support a statistical testing of the results, and research propositions were developed as an alternative.

Propositions are statements concerned with the relationships among concepts. At the explanatory level, a proposition is the logical linkage among concepts. A proposition asserts a universal connection between properties. A proposition states that every event or thing of a certain sort either has a certain property or stands in certain relationship to other events or things that have certain properties [160:19].

The propositions were stated in the null case and identified specific relationships examined by the research. The predicted directions reflected the direction of the relationships anticipated to be observed during the research. The case study data was used to ascertain the direction and magnitude of the studied relationships.

#### Proposition A - Size of the Organization

Proposition A1: The size of the firm and organization of logistics will have no impact on the number and types of benefits reported by logistics personnel.

Predicted: Large firms with centralized logistics management will experience more benefits from ABC implementation than smaller organizations

#### Rationale:

Large firms with centralized logistics management appear more likely to enjoy the benefits produced by an ABC system. Centralized logistics management has resulted from efforts to standardize operations and achieve economies of scale [95:48] [8:382] [43:494]; however, these conditions will also produce larger amounts of customer and product diversity. As a result, the firms may experience greater

cost distortions and cross-subsidization and would realize more benefit from implementing an ABC system.

Proposition A2:       The size of the firm will have no affect on the length of time required to implement an ABC system.

Predicted:           Larger organizations will require longer timeframes to implement ABC than smaller logistics organizations.

Rationale:

ABC implementation within larger logistics organizations will require a longer timeframe due to added customer and supply channel diversity. Cooper [29:33] and Turney [142:236] indicate a typical ABC implementation project will require three to six people working between three to four months with a total cost of approximately \$100,000. A study by the Institute of Management Accountants supported these figures with only 32 percent of the respondents indicating costs exceeding \$100,000. However, Turney [142:236] and Brausch [17:44] caution the time and cost will vary according to the complexity of the ABC system. ABC implementations within larger logistics organizations should therefore require additional time due to the complexity of determining how different customers and supply channels consume available resources.

## Proposition B — Organization of the Logistics Function

**Proposition B1:** The size of the firm and organization of logistics management will have no affect the complexity, measured in cost drivers and activities, and the sophistication, determined by size and frequency of cost and activity updates, of the ABC system.

**Predicted:** Large, centralized logistics organizations will implement more complex and sophisticated ABC systems than decentrally managed logistics organizations.

**Rationale:**

Firms typically centralize logistics management to obtain greater cost control, standardize operations, and achieve economies of scale [95:48] [8:382] [43:494]. Large firms with centralized logistics management will therefore encounter greater product and customer diversity than their decentralized counterparts. Cost distortions within these firms will increase as a result of significantly greater product and customer diversity [30:80]. Therefore, larger firms will have a greater interest in developing ABC as a cost management system to accurately allocate their indirect costs so as to overcome costing distortions. The data requirements and complexity of the system have caused similar large organizations to use a single cost management system [11:179]. Small, decentralized firms will experience less cost distortion and not require a sophisticated allocation mechanism.

Proposition B2: Centralization of logistics management will have no affect on whether the firm adopts ABC as a cost management system or uses ABC as a diagnostic tool.

Predicted: Centrally managed logistics organizations will adopt ABC as a cost management system, and decentrally managed logistics organizations will use ABC principally as a diagnostic tool.

Rationale:

Large firms with centralized logistics management confront greater product and customer diversity and will require a more complex ABC model for accurate costing. Firms typically centralize logistics management to gain greater cost control and achieve economies of scale; however, decentralization enables the firm to provide more customized services for specific customer requirements or to drive authority down to lower management levels to handle a differentiated customer base [8:382] [43:494] [95:48]. As a result, centralized logistics functions typically will experience larger amounts of product or customer diversity than decentralized logistics operations.

The increased product and customer diversity will drive a requirement for a more sophisticated ABC system. Cooper indicates ABC systems will become more complex as the amount of diversity increases. The ABC model will require using additional cost drivers to report accurate product costs [31:53]. ABC systems for larger, centralized logistics organizations must possess the capability to address

customer diversity and resolve the problems of service and cost "averaging" identified by Fuller et al. [62:90].

### Proposition C — Implementation Stages

**Proposition C1:**       The methodology employed for implementing ABC will not vary by the size of the firm.

**Predicted:**           ABC implementation for large and small logistics organizations will not deviate from the five implementation stages described in Chapter Two.

**Rationale:**

Turney suggests that the specific actions required for successfully planning and implementing an ABC system remain the same despite differences in needs, size, complexity, types of activities and processes, technology, products or services [142:226]. Warehousing and physical distributions studied by Lewis [101] and Roth and Sims [126] followed the same implementation steps proposed by Turney [142], Brimson [18], and Cooper [32] for manufacturing applications.

**Proposition C2:**       The number of major impediments, measured in number and type, will not differ by implementation stage.

**Predicted:**           The planning and design stages will encounter more impediments than the subsequent implementation stages.



**Rationale:**

The planning and design stages may present the greatest potential impediments to ABC implementation. Potential impediments during the planning stage include justifying the ABC system and gaining management support. Cooper suggests the cost to introduce and redesign a new cost system represents a significant barrier for ABC implementation. Proponents of ABC implementation must demonstrate the benefits exceed implementation costs [32:46]. Turney has also identified acceptance by senior management as an impediment to implementation. He contends successful ABC implementation will require management support and commitment of resources [142:209]. Campi also cautions ABC should not be viewed as a "quick fix." ABC requires a cultural change, and it should be one of a set of cultural change initiatives such as TQM, JIT, or time-based competition if maximum benefits are to be realized. [21:6].

The design stage presents a different set of impediments. The design of an ABC system requires several key decisions [34:38] [142:261] and the availability and access to a substantial amount of cost data. The implementation team must decide on the number of activities needed and which cost drivers to use [33:34]. The number of activities plays an important role in the model by determining the model complexity and accuracy [33:34-35]. The selection of cost drivers also impacts the ability of

the ABC system to accurately assign costs to the cost object [33:35] and to establish a causal relationship [18:135]

**Proposition C3:** Customer and product diversity will have no impact on the complexity and design of the ABC system.

**Predicted:** Logistics organizations will incorporate the same amount of complexity, or number of activities, as used for handling product diversity to overcome the cost distortions posed by customer diversity.

**Rationale:**

The biggest challenge confronting logistics centers on serving customers profitably through distinct, rationalized pipelines [62:88]. Customers, as do products, can consume resources in disproportionate amounts [142:237-238]. Logistics managers require the additional capability within an ABC system to accurately cost the services provided to individual customers and to eliminate cross-subsidization or "averaging," the under- and over-costing of different customer segments [62:90].

#### Proposition D — Logistics Decision-Making and Performance Measurement

**Proposition D1:** ABC implementation will not influence logistics managers' perceptions of their ability to effect changes in the total cost of the cost object.

**Predicted:** Logistics managers will perceive a greater ability under an ABC system to control and change the logistics costs traced to the cost object.

**Rationale:**

ABC systems trace the reduction in the cost of activities to the products that benefit from the reduction in time and effort [143:33]. The ABC analysis highlights for managers where their cost reduction efforts will likely have the greatest impact on profits [41:134]. Logistics managers will have the ability to translate the elimination of non-value added activities or a reduction in cost drivers into a cost savings on a specific cost object. Logistics managers can also use activity analyses to simulate how their actions may alter activity costs, the consumption of resources, and the total cost of the cost object [143:33].

**Proposition D2:** ABC implementation will have no impact on the performance measurement system for logistics by tracing management action to changes in the total cost of the cost object.

**Predicted:** Logistics organizations will incorporate the ABC results into their performance measurement system and will implement ABM as a result of ABC.

**Rationale:**

ABC provides the cost visibility required to link management action to cost consumption and product profitability [41:130]. Cooper and Kaplan contend that a firm can increase the profitability of a product through a combination of reducing the quantity of activities performed and increasing the efficiency of performing the remaining

activities. The actions allow the companies to maintain production and revenues while reducing the demand for indirect and support resources [37:11]. "Performance measures assist in the cost reduction effort by focusing on the significant activity levels and measuring the drivers of activities. In concert with the continuous improvement philosophy, performance measures have baselines and targets established to measure the impact of change promoted through the operational improvements identified in the process value analysis" [114:46].

Proposition D3:       ABC information will have no affect on how the researched organizations manage the selection of members or the structure of the supply chain.

Predicted:           Logistics organizations will use ABC data to select other members within the supply channel.

Rationale:

Tyndal indicates that competitive pressures will compel many companies to reexamine their selling and distribution channels and to seek more efficient alternatives. He recommends using a methodology which identifies the activities in the channel, the resources consumed, and the measures of resource consumption [146:45-46]. Porter also recommends using cost information for evaluating alternative channel structures: "A firm should select those suppliers which are most efficient or those that offer the least costly product to use given the firm's value chain"

[119:107]. Shank and Govindarajan indicate companies can use ABC to operationalize the supply chain relationships by identifying activities and cost drivers and tracing costs through the supply chain [130:5-21].

Proposition D4: ABC information will have no affect on the number of contacts measured in volume between the logistics functions and other functions within the firm.

Predicted: ABC implementation will increase the number of contacts between logistics and other departments within the firm.

Rationale:

The literature suggests that the increased availability of cost information will increase the contact required between logistics and other functions within the organization. Herr contends that senior logistics managers will need to work through their manufacturing, marketing, and sales counterparts to properly manage logistics costs and to support the strategic directions of the business [71:44]. Tyndal implies that the logistics function must overcome several potential conflicts with manufacturing, sales and marketing, and finance and control to make the necessary cost trade-offs to obtain a cost advantage [149:211]. The logistics function will need to coordinate and share cost information to preclude conflict and accomplish the required trade-offs.

**Proposition D5:** ABC information will not change the performance evaluation of the researched organizations for other organizations in the supply chain.

**Predicted:** The firms will use and exchange activity-based information to evaluate supply chain performance.

**Rationale:**

Quillian suggests that the increased importance of customer service and cost control will require firms to seek opportunities across the supply chain to reduce logistics costs. He recommends coupling supply chain management with ABC to identify, measure, and continually improve total logistics costs and time. Activity-based information will enable the supply chain members to identify the activities performed, trace supply chain costs to those activities, and to use cost drivers to track activity costs to specific processes and products flowing through the chain. Turney also suggests using ABC information for evaluating how other supply chain members, e.g. suppliers, drive costs within the organization [142:200-203].

**Proposition D6:** ABC implementation will have no affect on the amount of logistics overhead assigned to the cost object — brand, product, customer, or supply chain.

**Predicted:** ABC implementation will increase the amount of logistics overhead assigned to the majority of cost objects.

**Rationale:**

Several authors suggest that traditional accounting has "hidden" the true cost of logistics within the firm [101] [115] [120] [150]. Schiff's research found a lack of physical distribution [logistics] data in a usable form. Many costs were buried in vendor invoices or other cost centers such as marketing or manufacturing [127:1-1]. He also found the positioning of physical distribution in income statements distorted the reporting of logistics costs. The costs were frequently spread across multiple areas as part of sales, general, and administrative where logistics costs could not be traced to a specific product [127:3-10-3-15]. Quillian more recently found the true costs of logistics remained elusive and unusable [120:13]. Pendlebury and Platford also found many firms have hidden logistics costs for storage and materials handling. They contend that the hidden costs for materials handling alone may represent a larger and more significant controllable cost than direct labor [115:5]. Turney suggests ABC will more accurately depict costs within an organization by tracing resource consumption to activities [142:53]. As a result, ABC should capture more of the hidden costs of logistics and reflect a demonstrable increase in the magnitude of logistics costs and a decrease in some other cost category.

### Implementation of the Research Design

The research consisted of three phases. The first phase consisted of discussions with experts in the field to validate the research design, pretest the interview protocol, and select case study firms. Actions in the second phase included the collection of data through personal interviews and site surveys. The third phase was used to complete the research through data analysis, review, and interpretation, and reporting of the results.

#### Phase One Validation and Selection

Three steps comprised the validation and selection phase of the research. The first step consisted of validating the questions contained in the interview protocol. The second step pretested the interview protocol. The third step identified case study firms and interview candidates for the research.

#### Validation of Research Design and Interview Protocol

Validation of the interview protocol questions occurred by obtaining written feedback. The researcher contacted three logistics executives and a member of the accounting faculty and requested their review of the interview questions. The executives were asked to provide short, hand-written responses to the interview protocol questions. The executives simultaneously evaluated the clarity,



relevance, and time required for each question. The participants had the opportunity to recommend additional questions, revision of current questions, or deletion of redundant or less relevant questions; however, the feedback recommended greater concentration on ABM implementation. The executives reviewing the interview protocol accepted the opportunity to participate in the research as they expressed a continuing interest and their firm met the research criteria. The executives were asked to identify potential case study firms and a recommended point of contact within each firm. The executives' recommendations included firms already participating in the research or firms not meeting the research criteria.

#### Selection of Case Study Firms

The final step of Phase One was the identification and selection organizations to participate in the research. Identification of potential participants primarily occurred through a preliminary questionnaire and contacts identified by industry and academic experts. A preliminary questionnaire, Appendix A, was mailed to 100 firms meeting the research criteria and with a logistics or distribution vice-president position. The questionnaire had the dual purposes of identifying ABC issues and pretesting interest in the topic. Firms or organizations expressing an interest in the research were contacted for participation.

Eleven firms participated as case studies in the research. The preliminary questionnaire obtained agreement from four firms. Direct telephone and personal contact resulted in two firms and two government organizations agreeing to participate. An initial telephone interview identified another company which subsequently agreed to participate. Faculty contacts produced two participating organizations.

The research used a purposive selection technique. The researcher's judgement determined organizations selected to meet the purposes of the study [13:68]. As a result, the firms selected did not represent all logistics organizations. However, the research followed an approach of carefully selecting logistics organizations on the leading edge of business practice [92:3-4]. The selection of these firms, while not representative, may prove more indicative of future direction than obtaining a larger or representative database of current practice. Final selection of candidate firms occurred through a comparison of information obtained from the organization with the research criteria.

The researcher contacted candidate organizations appearing to meeting these criteria. Contacted individuals were asked several background questions, Appendix B, to determine whether the organization satisfied the research criteria. Organizations fulfilling the criteria and

agreeing to participate in the research were included as case study firms. The background questions also enabled classification of the organization into the research matrix by size and organization of the logistics function.

The in-person interviews had the objective of obtaining detailed information regarding ABC implementation and its effect on the logistics function. A limited number of interviews and the requirement for thorough knowledge of ABC implementation made interview candidate selection critically important. The researcher asked the organization's contact point to identify or recommend two other potential interview candidates having a major role in ABC implementation or in the reporting, analysis or end use of ABC data. The contact point was asked to provide an advance notification to those individuals of a possible contact by the researcher.

The researcher made at least two and up to three interview contacts within the organization to obtain inputs from logistics, accounting, and the key decision maker involved in ABC implementation. The multiple contacts provided greater depth into how ABC has effected the organization as well as providing a wider range of opinions and cross validating the results.

## Phase Two Data Collection and Analysis

### Survey Method

Data collection occurred in the form of personal interviews at the respondent's place of business. Personal interviews enabled the interviewer to fully explore ABC implementation by offering the opportunity for feedback, probing complex answers, facilitating a longer interview timeframe, obtaining a more complete questionnaire, permitting the use of visual aids, and achieving a higher participation rate from individuals within the organization [160:163-164]. Personal interviews also offered the advantages of providing the interviewer with the capability to adapt the interview to solicit cooperation and build rapport [48:354] and the flexibility to probe for more specific answers or to reword questions the respondent misunderstood [13:168].

The interview protocol contained in Appendix C provided a framework for the in-person interviews. The respondents received identical interview protocol forms. The interviewer adjusted the interview format to accommodate organizations in different stages of ABC implementation.

### Survey Content

The interview protocol consisted of four parts. Part One obtained background information regarding the organization. Part Two concentrated on discussing the ABC

implementation process. Part Three focused on obtaining information on the reporting of logistics costs and also sought information on how ABC had altered logistics decision-making and the organization's performance measurement systems. Part Four focused on logistics perceptions regarding how ABC has impacted the organization.

During the interview, the respondent was specifically asked to discuss:

1. General background information regarding the organization and structure of the logistics function. The interview requested an organization chart for logistics and the entire organization. The information established the range of activities assigned to logistics, the type of organization and product handled, and the volume and value of transactions involving logistics activities.
2. The process selected for use in ABC implementation. The respondent identified who initiated or "championed" ABC implementation and traced the implementation from problem definition to operational use. The questions supported the development of an implementation guide for use by other organizations considering an ABC system.
3. Decision-making and the performance measurement system. The questions examined how ABC had altered logistics decision-making and identified specific areas where ABC information affected previous decisions. The questions also determined whether the performance measurement system has changed under ABC implementation, the role of cost information, and how the organization uses cost information to evaluate performance by internal functions and organizations within its supply chain.
4. Logistics perceptions of ABC implementation. Logistics respondents provided their viewpoints regarding how ABC has affected workload, reporting, contacts and relationships with other organizations, and the planning and management of their functions.

Respondents received an advance telephone call and then a copy of the interview protocol. The initial contact by telephone discussed the major topic areas addressed within the interview protocol and offered the organization a final opportunity to decline if they felt hesitant or unwilling to discuss any of the topics contained in the interview protocol. Receipt of an advance copy of the interview protocol provided the respondents with an opportunity to structure their answers in advance of the interview, identify unclear questions, obtain additional information within their organization, and reduce the time spent during the interview.

The research employed a variety of techniques to encourage organizations to participate in the study. The initial survey solicited the respondents to participate in the research to obtain additional information regarding ABC applications and to benchmark their systems. Firms expressing an interest in the research received background information regarding ABC and ABM collected during the literature review. They also received the results of the survey and a bibliography of current ABC articles and books. Firms identifying specific issues regarding their ABC system received copies of relevant articles or papers. The participating organizations also received a summary report of the research's findings and conclusions.

### Phase Three Data Analysis and Reporting of Results

#### Analysis Method

A detailed description of the data analysis is presented in Chapter Four; however, the following paragraphs provide an outline of the general approach the research followed. The research took a descriptive and a prescriptive approach.

#### Descriptive Approach

The descriptive part of this research discussed the ABC implementation process used by business and government organizations and how ABC has impacted the logistics function. The researcher formed a narrative description or framework of each organization's implementation process and experiences from the interview responses and documentation obtained during site visits. Comparisons of the implementation processes and organizational summary descriptions were used to determine where commonalities and disparities exist between organizations. The analysis also compiled results by quadrant of the research matrix as shown in Table 6. Analysis by quadrant suggested significant differences or trends such as by organization of the logistics function and size. The validity of the propositions were examined using the data collected during the case studies. The limited number of case studies, the

use of qualitative data, and the exploratory nature of the research precluded the use of quantitative analysis.

The research used a qualitative research approach for developing a grounded theory [138] regarding the effect of ABC on logistics decision-making and relationships within the supply chain and the internal and external relationships of the logistics function. The approach coded, or classified, the data elements contained in the implementation flow chart and narrative framework. The coding facilitated the comparison and further classification of the data collected from the participating organizations. The coded data was analyzed by making connections between different data categories and developing potential linkages and relationships. The systematic development of linkages and subsequent validation of relationships permitted the research to develop an overall framework to integrate the collected data. The resulting framework was used to establish relationships between the implementation of an ABC system and the observed results or sequences of events.

The descriptive portion of the research covered the following topics regarding ABC implementation within logistics:

The effect of ABC on logistics decision-making.

The effect of ABC on the evaluation of logistics performance and reporting of logistics costs.

The effect of ABC on intra-organizational relationships.



The effect of ABC on inter-organizational relationships.

The ABC implementation processes followed by the participating organizations.

Implementation impediments confronted by the researched organizations.

The benefits and critical success factors achieved by organizations with operational ABC systems.

The logistics manager's perceptions of ABC implementation.

### Prescriptive Approach

The prescriptive portion of the study developed several guidelines for implementing an ABC system and managing change during implementation within a logistics organization. Observations made during the interview process and literature review provided the basis for forming the implementation guideline. The prescriptive portion of the research differed from the descriptive approach by suggesting how organizations should design and implement ABC to overcome the impediments confronted by the case study organizations. The prescriptive portion also differed by recommending how firms should report logistics costs and measure the performance of logistics functions, both internal and external to the organization. The recommendations for ABC implementation and reporting are presented in Chapter Five.

### Summary

Chapter Three outlined the research methodology used to analyze ABC's impact on logistics. The methodology employed personal interviews to perform case study analyses due to the exploratory nature of the research, the requirement for in-depth investigation, and the need to fully explore the effect of ABC on inter- and intra-organizational relationships. The results obtained from the research are contained in Chapter Four.

## CHAPTER IV

### RESULTS OF THE STUDY

#### Introduction

This chapter presents the results of the site visits performed with the eleven participating organizations included in the research. Two sections comprise the chapter: (1) findings relative to the research propositions, and (2) other findings. The first section reviews each research proposition and presents the respective research finding. The research categorized the propositions by research variable into four major areas of interest: size of the organization, implementation stage, organization of the logistics function, and logistics decision-making and performance measurement. The second section presents other findings related to ABC implementation and logistics decision-making but not directly associated with the research propositions. The categories of related findings include: other findings regarding ABC implementation, other findings regarding ABC system design, and other findings regarding performance measurement.

### Section One – Findings Relative to the Research Propositions

The propositions covered in this section address the four research variables of size of the firm, stage of ABC implementation, organization of the logistics function, and logistics decision-making and performance measurement. The research presents the results in two stages for each proposition. The first stage presents the results of testing the proposition. The second stage presents the results of testing the predicted direction of the impact. The research rejected or accepted the propositions and the predicted direction by using a consensus level of two-thirds of the participating firms. A two-thirds consensus organizations allowed the researcher to establish a reproducible relationship or linkage while permitting unique or possible exceptions. The following paragraphs report the results for the propositions and predicted directions.

#### Size of the Organization

The research examined two propositions regarding the size of the firm. The first proposition addressed the benefits perceived in relation to size and organization of logistics. The second proposition concentrated on the length of the implementation process as a function of size. The measurements used to evaluate the propositions resulted from responses to the interview protocol [Appendix C] questions in Part I; questions 1, 3, 6, 8, 9, and 15 in Part

II; questions 4, 7, and 8 in Part III; questions 3, 8, 9, 10, 12, 13, 14, 18, 20 and 22 and the attitude responses in Part IV.

Proposition A1:       The size of the firm and organization of logistics will have no impact on the number and types of benefits reported by logistics personnel.

Results:               Proposition accepted.

Predicted:            Large firms with centralized logistics management will experience more benefits from ABC implementation than smaller organizations.

Results:               Prediction not supported.

Findings:

All ten of the organizations implementing an ABC system reported ABC as beneficial. Large firms with centralized logistics management experienced a wider range of benefits than the other categories of firms; however, the average large firm with centralized logistics management did not experience an increased number of identified benefits than large firms with decentralized logistics management. Both averaged 14 per firm. Large firms reported more benefits resulting from ABC implementation, 70, than reported by small firms, 56. Firms with centralized logistics management reported more benefits resulting from ABC implementation, 72, than reported by firms with decentralized logistics management, 54. Using a two-thirds consensus measure, the research results accepted the

proposition, and the prediction that larger firms with centralized logistics management would experience more benefits was not supported.

TABLE 7  
BENEFITS IDENTIFIED BY LARGE FIRMS

Benefits Identified	Large Firm Decentralized (N=2)	Large Firm Centralized (N=3)
Accurate Overhead Cost Allocation	1	2
Cost Trade Damage		2
Understand & Cost Key Processes	2	2
Increased Communications	1	1
Provide Basis for New Cost System	1	3
Prioritize Cost Reduction Actions	1	1
Understand, Identify, and Control Cost Drivers	2	2
Visibility of Logistics Costs	1	1
New Product Costing		2
Diagnostic Tool		2
Cost Reduction	2	
Costing by SKUs, Products, & Brands	1	3
Costing by Region		1
Costing by Customer		1
Costing by Shipment	1	
Activity Analysis	2	2
Internal Cost Comparisons	1	1
More Accurate Cost Information	2	2
Support TQM, CIM, JIT Strategies	2	2
Input for Pricing Decisions	2	2
Support Cost Trade-off Analyses	1	2
Evaluate Partnersshipping or Supply Chain Costs	1	1
Where to Focus Marketing Effort	1	
Explain Cost or Rate Changes	1	3
Customer Profitability	1	1
Reallocation of Resources	1	1
Product Profitability		2
Total:	28	42

TABLE 8  
BENEFITS IDENTIFIED BY SMALL FIRMS

Benefits Identified	Small Firm Decentralized (N=2)	Small Firm Centralized (N=3)
Accurate Overhead Cost Allocation	2	
Cost Trade Damage		
Understand & Cost Key Processes	1	2
Increased Communications	2	1
Provide Basis for New Cost System	1	
Prioritize Cost Reduction Actions	1	2
Understand, Identify, and Control Cost Drivers	2	3
Visibility of Logistic Costs	2	3
New Product Costing	1	
Diagnostic Tool	1	1
Cost Reduction	1	1
Costing by SKUs, Products, & Brands	2	1
Costing by Region		1
Costing by Customer		1
Costing by Shipment		
Activity Analysis	1	3
Performance Measurement System		1
More Accurate Cost Information	2	2
Support TQM, CIM, JIT Strategies	2	1
Input for Pricing Decisions	1	
Support Cost Trade-off Analyses	2	1
Evaluate Partnersshipping or Supply Chain Costs		1
Where to Focus Marketing Effort		2
Explain Cost or Rate Changes	1	
Customer Profitability		1
Reallocation of Resources		2
Product Profitability		
Total:	26	30



Proposition A2: The size of the firm will have no affect on the length of time required to implement an ABC system.

Results: Proposition accepted.

Predicted: Larger organizations will require longer timeframes to implement ABC than smaller logistics organizations.

Results: Not supported.

Findings:

Table 9 reflects the implementation times reported by firms participating in the research.

TABLE 9  
TIME REQUIRED FOR  
IMPLEMENTATION OF AN ABC SYSTEM  
(N=8)

Length	Small Firms	Large Firms
Less than 3 months	3	1
3 - 6 months	1	1
7 - 12 months		
13 - 18 months		1
18 - 24 months	1	

Large firms do not require a significantly longer implementation time for ABC than small firms. Only one of the large firms had a longer implementation time than the average implementation time reported by the small firms.

Eight firms of the eleven had completed implementation of an ABC system. The three large firms averaged 9 months for ABC implementation while five small firms averaged 7.8 months. Using the two-thirds consensus measure, the proposition is accepted, and the prediction that large firms would require longer implementation times is not supported.

### Organization of the Logistics Function

The research examined two propositions addressing the organization of the logistics function. The specific issues explored included the effect of the logistics organization on the complexity of the ABC system and adoption of ABC as a cost management system or diagnostic tool. The measurements used to evaluate the propositions resulted from the questions contained in Part I; questions 8, 9, 10, 13, 16 - 21, and 25 in Part II; questions 1 - 3 in Part III; and question 11 in Part IV.

**Proposition B1:** The size of the firm and organization of logistics management will have no affect on the complexity, measured in cost drivers and activities, and the sophistication, determined by the size and the frequency of cost and activity updates, of the ABC system.

**Results:** Proposition rejected.

**Predicted:** Large, centralized logistics organizations will implement more complex and sophisticated ABC systems than decentrally managed logistics organizations.

Results: Prediction supported.

Findings:

Large firms with centralized logistics management generally implemented more complex and sophisticated ABC systems than the other researched firms. The number of cost drivers and the frequency of cost updates to the ABC system by organization are shown in Table 10. The level of complexity, measured by the number of cost drivers, varied by type of organization, the level of detail required for specific analyses, and the aggregation of related or highly correlated micro activities into macro activities. The

TABLE 10  
IMPACT OF SIZE AND ORGANIZATION OF LOGISTICS  
ON THE COMPLEXITY AND SOPHISTICATION OF  
THE ABC SYSTEM

Size of the Organization	Organization of the Logistics Function	
	Centralized Management	Decentralized Management
Large	20 Cost Drivers Updated Weekly	35 Cost Drivers Updated As Needed
	25 Cost Drivers Updated Daily	90 Cost Drivers Updated Quarterly
	83 Cost Drivers Updated Quarterly	
Small	15 Cost Drivers Updated As Needed	21 Cost Drivers Updated Daily
	25 Cost Drivers Updated As Needed	120 Cost Drivers Updated Quarterly
	40 Cost Drivers Updated Annually	

large centralized firms used approximately the same number of cost drivers as the other categories of firms; however, the numbers reflect a substantial variance in the number of cost drivers used in the ABC systems. The two government organizations used more cost drivers than found in the business organizations. The government ABC applications encompassed a much wider range of logistics activities than included by the business organizations.

The large organizations with centralized logistics management also implemented more sophisticated ABC systems. Sophistication was determined by the frequency of updates to the ABC system and the type of database or computer system used to support ABC. Two of the large, centrally managed organizations used main-frame computers with relational databases and updated their ABC system on a daily or weekly basis. The third used a software package requiring manual updating on an as needed basis. The large, centralized firms using relational databases could run inquiries to divide the database by cost of product, mode, or activity. One organization could also obtain individual customer costs and relate activity costs directly to the general ledger accounts. The research detected only one organization not falling into the large, centralized category possessing the same amount of complexity and sophistication. The remainder of the organizations used PC-based systems with software

comprised of interlinked spreadsheets and updated their systems on an as needed basis.

Using a two-thirds consensus measure, the proposition is rejected, and the prediction that larger firms with centralized logistics management would implement more complex and sophisticated ABC systems is supported.

Proposition B2:        Size and centralization of logistics management will have no affect on whether the firm adopts ABC as a cost management system or uses ABC as a diagnostic tool.

Results:                Proposition rejected.

Predicted:            Large firms with centrally managed logistics organizations will adopt ABC as a cost management system, and decentrally managed logistics organizations will use ABC principally as a diagnostic tool.

Results:                Prediction supported.

Findings:

Large firms with centrally managed logistics generally adopted ABC as a cost management system. The numbers adopting ABC as a cost management systems are shown in Table 11. Two-thirds of the large firms had replaced their conventional cost system with ABC. The third firm initiated ABC to develop a new cost system, but elected not to implement ABC following its pilot program. The remaining seven firms used ABC as a diagnostic tool for analyzing key processes, prioritizing improvement actions, performance measurements, or periodically reporting costs for processes,

activities, or cost objects. The other firms did not express any intent to expand ABC beyond its role as a management diagnostic tool. Using a two-thirds consensus measure, the proposition is rejected and the prediction that large firms, with centralized logistics management would implement ABC as a cost management system is accepted.

TABLE 11  
TYPE OF ABC IMPLEMENTATION

Type of ABC System	Type of Firm (N=10)			
	Large Centrally Managed (N=3)	Large Decentrally Managed (N=2)	Small Decentrally Managed (N=2)	Small Centrally Managed (N=3)
Cost Management System	2			
Diagnostic Tool for Management	1	2	2	3

#### Implementation Stages

Three research propositions examined the implementation process used by the participating firms. The first proposition focused on whether the size of a firm would effect the methodology employed. The second proposition attempted to determine where the firms would encounter the most significant impediments during implementation. The third proposition addressed the impact of customer and product diversity on the design of the ABC system. The

measurements used to evaluate the research propositions resulted from the responses to the questions contained in Part II; question 5 in Part III; and question 21 and the attitude responses in Part IV of the interview protocol.

Proposition C1:       The methodology employed for implementing ABC will not vary by the size of the firm.

Results:               Proposition accepted.

Predicted:            ABC implementation for large and small logistics organizations will not deviate from the five implementation stages described in Table Four of Chapter Three.

Results:               Prediction supported.

Findings:

Nine of the ten of the organizations implementing an ABC system followed the sequence of actions described in Table Four. Several of the organizations used more stages for planning their implementation process than the five stages identified in Table 4. However, the implementation processes followed the same sequence of actions, and the additional stages or increments occurred due to the preference of the individual organization and the literature or consulting firm most influential in their decision to implement ABC. The type of system employed, a cost management system versus a diagnostic tool, affected the amount of resources expended during each stage. Diagnostic tools represented the application of the ABC methodology to

solve a specific problem or to focus a process reengineering effort. ABC systems intended to replace or supplement the cost management system required a larger expenditure of human and computer resources than the development of ABC as a diagnostic tool.

One firm did not report the explicit use of the methodology. Their ABC system had evolved over time to meet more accurate product costing and overhead allocation requirements. The firm did not form an implementation team or perform a detailed activity analysis. The changes in the cost system captured the information as the system attempted to eliminate sources of cross-subsidization.

Using the two-thirds consensus measure, the proposition was accepted and the prediction that large and small firms would not deviate from the implementation methodology described in Table 4 was supported.

Proposition C2:      The number of major impediments, measured in number and type, will not differ by implementation stage.

Results:              Proposition rejected.

Prediction:          The planning and design stages will encounter more impediments than the subsequent implementation stages.

Results:              Prediction not supported.



### Findings:

The respondents identified the major impediments encountered during ABC implementation. The impediments identified by the respondents are shown in Table 12. The data collection stage had the most impediments identified, by number and type, with a total of ten. The design stage had eight impediments identified. The planning stage had four, and the problem definition stages had a total of two impediments identified. Almost all of the organizations reported problems with data accessibility or in determining an appropriate level of detail for logistics costing. The organizations also reported difficulty in gaining division management acceptance of how the ABC system allocated logistics costs between product or marketing divisions.

Using the two-thirds consensus measure, the research proposition was rejected, and the predicted direction of the design and planning stages encountering the most impediments was not supported.

TABLE 12  
IMPEDIMENTS IDENTIFIED BY  
IMPLEMENTATION STAGE

Implementation Stage:	Impediments Identified:
Problem Definition	<ul style="list-style-type: none"> <li>• Training and obtaining a consensus on terminology</li> <li>• Pilot site poorly chosen--drove many of the problems encountered by the project team</li> </ul>
Planning	<ul style="list-style-type: none"> <li>• Human resources too limited</li> <li>• Not enough training for project team</li> <li>• Needed clearer objectives</li> <li>• Initial scope too large--should have begun with a limited pilot to increase understanding.</li> </ul>
Data Collection and Analysis	<ul style="list-style-type: none"> <li>• Cost data not in a usable form (3)</li> <li>• Cost data not readily available</li> <li>• Too many joint or common costs</li> <li>• Delays in getting supervisors to provide or validate data</li> <li>• Quantity of data--numerous transactions even on "penny parts"</li> <li>• An organization not responding to request for data</li> <li>• Workers initially viewed as an effort to cut positions or costs</li> <li>• Personnel had no incentive to reduce costs or overtime</li> </ul>
Design	<ul style="list-style-type: none"> <li>• Handling of deferrals</li> <li>• Determining level of detail or aggregation for costing (2)</li> <li>• Level of detail--everyone wanted more detail to answer specific questions</li> <li>• Changing environment--processes and activities changed before model could become finalized</li> <li>• Finding a highly correlated cost driver which accurately depicted a cause and effect relationship (2)</li> <li>• Deciding how to assign or allocate large volume of fixed costs</li> </ul>
Operational	<ul style="list-style-type: none"> <li>• Brand or division managers challenging or initially rejecting new logistics cost allocations (3)</li> <li>• Obtaining division management approval for standardizing logistics costing</li> </ul>

Proposition C3: Customer and product diversity will have no effect on the complexity and design of the ABC system.

Results: Proposition accepted.

Predicted: Logistics organizations will incorporate the same amount of complexity, or number of activities, as used for handling product diversity to overcome the cost distortions posed by customer diversity.

Results: Proposition not supported.

Findings:

All of the firms incorporated cost drivers and objects to address either product or customer diversity. Four of the ten firms implementing an ABC system reported high customer and product diversity. Three firms reported high customer and low product diversity, and the remaining three reported low customer and high product diversity.

Customer diversity played a major role in ABC system design in only four of the ten firms. The four firms had incorporated cost drivers and cost objects into the design of their ABC system to capture the impact customer diversity had on logistics costing. Only three of the nine firms experiencing high customer diversity had included cost drivers and objects to reflect customer diversity. Two other firms with high customer and product diversity indicated their systems possessed the information to isolate logistics costs by customer, but their ABC systems did not include additional cost objects to trace logistics costs to the customer.

The four ABC systems tracing logistics costs to the customer also differed in their approach. Three of the firms used different cost objects rather than cost drivers to trace costs to the customer. The customers rather than the products became the objects for assigning costs. The fourth firm designed its ABC system specifically for developing and managing strategic partnerships. The cost drivers and objects used reflected a strong customer orientation and would not readily convert for tracing logistics costs to a product.

The results of applying the two-thirds consensus measure accepted the research proposition and did not support the predicted direction that logistics organizations would incorporate the same amount of complexity to overcome the potential cost distortions posed by customer diversity as posed by product diversity.

TABLE 13  
IMPACT OF PRODUCT AND CUSTOMER DIVERSITY  
ON THE DESIGN OF THE ABC SYSTEM

Diversity Captured in the ABC System	Diversity Reported (N=10)		
	High Customer High Product (N=4)	High Customer Low Product (N=3)	Low Customer High Product (N=3)
Product	3	2	1
Customer		1	
Product and Customer	3		

### Logistics Decision-Making and Performance Measurement

Six research propositions examined the effect of ABC on logistics decision-making and performance measurement. The propositions address the effect of ABC on the total of logistics costs traced to the cost object, logistics performance measures, logistics decision-making, internal relationships, and external relationships. The measurements for these propositions resulted from the responses to the questions contained in Part One; questions 6, 8, 9, 10, 17, 18, and 21 in Part Two; questions 1, 2, 4, 5, and 8 in Part Three; and the questions contained in Parts Four and Five of the interview protocol.

Proposition D1:      ABC implementation will not influence logistics managers' perceptions of their ability to effect changes in the total cost of the cost object.

Results:              Proposition rejected.

Predicted:            Logistics managers will perceive a greater ability to control and change the logistics costs traced to the cost object.

Results:              Prediction supported.

#### Findings:

The respondents generally agreed with statements "ABC information will enable me to improve my operations," "ABC use will reduce costs," and "ABC implementation will improve logistics efficiency." One respondent strongly agreed with the statements, one disagreed, and the remainder agreed.

The respondents agreeing with statements that indicated ABC would enable them to increase efficiency and reduce logistics costs through several techniques. Representative responses included:

"If we are interested in lowering costs, we need to know the relative value of activities and understand what drives them."

"Supports other management techniques such as TQM, JIT, etc."

"Provide information for analysis and decision-making such as make/buy and addition or deletion of products."

". . .provided a 'step' change in the loading process. Eliminated nonvalue-added activities. . ."

All of the respondents implementing an ABC system indicated ABC alone would not result in reduced logistics costs, the elimination of nonvalue-added activities, or improved efficiency. They indicated ABC must support an "umbrella" program such as total quality management, customer service, or another management initiative to effect an improvement or cost reduction. The ABC information provided the magnitude of nonvalue-added costs and assisted in prioritizing objectives, establishing key performance indicators, or developing "as is" and "should be" models for continuous improvement efforts. The respondent disagreeing with the statements contained in Part Four of the interview protocol voiced these same concerns.

Six of the ten firms cited examples where ABC led to a cost reduction and streamlined operations. Three of the firms indicated that the identification of nonvalue-added activities during the activity analysis as having already produced cost savings ranging from "moderate" to "significant." Three of the firms stated more accurate cost information had enabled them to reduce costs by making better cost trade-off decisions. The remaining four firms have identified opportunities for eliminating nonvalue-added activities or making better cost trade-offs but had not completed their analyses of the ABC data.

The research used the two-thirds consensus measure to reject the proposition and support the prediction that logistics managers would perceive a greater capability to control and effect changes in the logistics costs traced to the cost object.

Proposition D2:      ABC implementation will have no impact on the organization's performance measurement system for logistics by tracing management action to changes in the total cost of the cost object or to reductions in the volume of cost drivers.

Results:              Proposition accepted.

Predicted:            Logistics organizations will incorporate the ABC results into their performance measurement system and will implement ABM as a result of ABC.

Results: Prediction not supported.

Findings:

The research found only one firm using ABM or incorporating activity-based information into its performance measurement system. None of the remaining nine firms with ABC systems had incorporated activity-based measurements into their evaluation system.

The firm using ABM had incorporated the information into its performance measurement system through three different approaches. First, they used the activity analysis to identify and prioritize activities for elimination or reduction. The project team selected activities based on the criteria of measurability, impact, and ability to track improvement. The firm used "key performance indicators" (KPIs) to translate the activity and corresponding cost into a meaningful objective for the workforce. The project team used the cost and impact of the KPIs to form a prioritized project list. Managers periodically reported their progress on the KPIs to the corporate office. Savings resulting from achieving the KPIs remained in the plant, and managers could reallocate the resources to effect improvements in other areas. Second, the firm included the KPIs into the reward system. Workers responsible for an activity with a corresponding KPI received a cash incentive for accomplishing the objective. Third, the firm included activity-based measures into the



personnel evaluation system. Managers and workers received evaluations were partially based on their ability to meet activity-based targets.

Six of the eleven firms participating in the research indicated an interest in pursuing ABM. The firms viewed ABM as a means to influence the direction of day-to-day operations and costs over the long run. ABC provided the firms with a substantial amount of non-financial information regarding their operations, and the performance measures would provide feedback regarding how well they have performed and whether improvement actions have taken effect. The firms had only limited exposure to ABM and would require additional information before making a decision on whether to implement ABM.

The respondents from the remaining five firms did not indicate an interest in using ABC data within their performance measurement system. Three firms used ABC primarily as a diagnostic tool and did not foresee expanding the system to routinely capture data for a performance measurement system. The other two systems used ABC data primarily for assigning logistics overhead costs or for supporting other performance measurement systems such as total quality management.

The research accepted the proposition using the two-thirds consensus measure, and the results did not support the predicted direction that logistics organizations would incorporate ABC into their performance measurement system.

Proposition D3:      ABC information will have no affect on how the researched organizations manage the selection of members or the structure of the supply chain.

Results:              Proposition accepted.

Predicted:            Logistics organizations will use ABC data to select other members within the supply channel.

Results:              Prediction not supported.

Findings:

None of the firms had used ABC information to manage or select the membership within their supply chain, except for carrier selection. All of the firms participating in the research believed their ABC system would eventually play an integral role in supply chain membership. ABC represented a recent development in all but one instance, and the firms expressed a need to drive any excess costs out of their own system before approaching or sharing cost data with a supply chain member. Six of the firms indicated that their ABC systems would include activities enabling them to cost specific supply chain relationships. Costs captured would include order processing, inspection, returned or damaged goods, material handling, packaging, and transportation.

One firm had plans to exchange order processing costs produced by its ABC system within potential partnership relationships. The firm planned to perform a joint ABC analysis of the order fulfillment process with its supply chain partners. The ABC analysis would identify opportunities where implementing electronic data interchange (EDI) would yield a cost savings by eliminating labor intensive or nonvalue-added activities. The partners would also use the ABC information to identify other techniques to jointly drive down activity costs within the partnership especially in the areas of volume of purchase orders, direct ship versus use of a distribution center, and the number of lines per purchase order.

Three of the firms used ABC information for evaluating carrier performance. Their evaluations primarily consisted of the same performance measures as used prior to ABC implementation; however, ABC enabled the firms to more accurately assign indirect logistics costs to activities such as processing damaged or returned goods, material handling, packaging, or customer service. The firms did exchange the cost information with their carriers as part of their evaluation process.

The research accepted the proposition using the two-thirds consensus measure, and the results did not support the prediction that logistics organizations would use ABC data to select other members within the supply channel.

Proposition D4: ABC information will have no affect on the number of contacts measured in volume and type, between the logistics function and other functions within the firm.

Results: Proposition rejected.

Prediction: ABC implementation will increase the number of contacts between logistics and other departments.

Results: Prediction supported.

#### Findings:

All ten of the firms implementing ABC reported increased contact between logistics and other functions within the firm. The factors influencing increased contact are shown in Table 14. The increased contact volume primarily resulted from discussions regarding product profitability, discussing how logistics effected other activities and processes within the firm, cost trade-offs between logistics and another function, the allocation of logistics costs, and identifying cost drivers and attempting to reengineer key processes.

Logistics financial managers and implementation team members experienced the greatest increase in contacts with other functions within the firm. The financial members of the team experienced increased contact due to changes in logistics cost allocations and for information needed for making cost trade-offs. Other departments would request ABC data to understand why their allocation of indirect costs

from logistics had changed or to evaluate potential trade-offs, such as make versus buy or increased production versus storage. The implementation team members stated increased contact continued after implementation due to their understanding of how logistics interacted with other key business processes. Three firms had the team members personally do the work performed in the different activities to fully understand each activity and cost driver. They received requests to participate on reengineering, continuous improvement, quality, or customer service initiatives.

The research rejected the proposition using the two-thirds consensus measurement, and the results supported the prediction that ABC implementation would increase the amount of contact between logistics and other functions within the firm.

TABLE 14  
 FACTORS INFLUENCING INCREASED CONTACT BETWEEN  
 LOGISTICS AND OTHER FUNCTIONS  
 WITHIN THE FIRM  
 (N=10)

Factor Influencing Increased Contact:	Number of Organizations Reporting:
Assignment of logistics costs to other functions	6
Discussion of how logistics activities impacted other functions' costs	8
Use of ABC data to evaluate cost trade-offs with logistics	8
Reengineer business processes	9
Focus marketing effort	4
Customer profitability	5
Product profitability	8
Costing of Quick Response Relationships	2
Comparison of Costs Between Distribution Centers	2
New Product Pricing	2
Reallocate available resources	2
Cost simulations	3

Proposition D5: ABC information will not change the researched organization's performance evaluation of other organizations in the supply chain.

Results: Proposition accepted.

Predicted: The firms will use and exchange activity-based performance information to evaluate supply channel performance.

Results: Prediction not supported.

Findings:

Only three of the firms had actually altered the methods used for evaluating the performance of other members within their supply chain. However, six of the firms had planned to use ABC data either to evaluate the costs of doing business with upstream or downstream members in the supply chain. The reported use of ABC for evaluating supply chain performance is shown in Table 15.

Planned uses for ABC as an evaluation mechanism focused primarily on measuring vendor costs and evaluating customer profitability. Four of the firms had initiated activity measures to specifically track the cost of purchasing from different vendors. The activities tracked included order placement, follow-up and expediting, inspection, and quality. Five of the firms planned to trace logistics costs to obtain profitability by customer; however, only three of the seven possessed the capability to assign costs by customer.

Actual use of ABC data focused on evaluating carrier or mode performance. Three of the firms used ABC to track loss, damage, and returns as part of their evaluation of carrier mode performance. ABC enabled the firms to more accurately capture the total costs of performing these activities. The cost information was passed to the carrier for action and as an evaluation tool.

The research proposition was accepted using the two-thirds consensus measure, and the results did not support the prediction that the case study firms would use and exchange activity-based performance information to evaluate supply channel performance.

TABLE 15  
PLANNED AND ACTUAL USES OF ABC  
FOR EVALUATING SUPPLY CHAIN PERFORMANCE

Measurement Application:	Reports of Actual Use	Reports of Planned Use
Total Cost of Purchasing from Different Vendors		5
Customer Profitability		7
Loss, Damage, and Returns	3	1
Cost by Mode of Shipment		1
Cost by Distribution Channel		1



Proposition D6: ABC implementation will have no affect on the amount of logistics overhead assigned to the cost object — brand, product, customer, or supply chain.

Results: Proposition rejected.

Predicted: ABC implementation will increase the amount of logistics overhead assigned to the majority of cost objects.

Results: Prediction not supported.

Findings:

All of the organizations reported changes in the logistics overhead assigned to the cost object. The change in the overhead cost assignment resulted from a more accurate tracing of costs and not to an increase in total logistics costs. None of the organizations reported an increase in total logistics costs as a result of ABC implementation. A change to total logistics costs would have resulted from redefining some "hidden" activities and costs such as material handling within the manufacturing process as part of total logistics costs. None of the organizations changed their definition or scope of responsibility as a result of ABC implementation. The ABC models used in the researched organizations focused solely on logistics costs and did not include the costs of other functions in the organization. As a result, the organizations did not redefine or increase their total logistics costs.

The firms experienced cost shifts similar to those reported by Turney [142:5]. Products or customers with high volumes but with low variety generally experienced a decrease in assigned costs. Low volume, high variety products and customers experienced sharp increases in cost assignments. One firm reported the typical situation, "Eighty percent of our items did not experience a major shift in costs. Large, bulk customers experienced a slight decrease. Twenty percent of the customers requiring specialized services experienced significant cost increases." The other nine firms did not actually track the changes resulting from ABC implementation; however, eight anticipated similar results. Two respondents indicated brand managers of high volume products requiring minimum logistics services experienced a decrease in the logistics cost allocation assigned to their profit and loss statement. However, logistics cost allocations increased for low volume products requiring unique or specialized logistic services. Six of the remaining firms noted cost increases and decreases on a small percentage of items or customers, under 20 percent of their previous cost.

The research rejected the proposition using the two-thirds consensus measure. The research did not find evidence to support the prediction that ABC would increase the amount of logistics overhead assigned to the majority of cost objects.

## Section Two -- Other Findings

The discussions with the eleven organizations participating in the research revealed several findings not directly related to the research propositions but relevant to implementing ABC in logistics and determining the impact on logistics decision-making. The other findings addressed the areas of ABC implementation, ABC system design, and performance measurement. The findings resulted from the responses to the questions in Parts II; question 7 in Part III; and the questions in Part IV of the interview protocol.

### Other Findings Regarding ABC Implementation:

Issue: Justification for ABC System Development

#### Findings:

None of the ten firms which have initiated or implemented an ABC system used cost avoidance or a cost-benefit analysis to justify developing an ABC system. These findings confirm the results obtained in the initial ABC questionnaire, Appendix D. All of the firms reported a need for more accurate costing as part of their justification. Table 16 includes the justification cited during the research.

TABLE 16  
JUSTIFICATION REPORTED FOR  
DEVELOPING AN ABC SYSTEM FOR LOGISTICS  
(N=10)

Justification Reported:	Number of Firms:
Part of a Larger Initiative	5
Development of a New Cost System	3
Greater Visibility of Logistics Costs Needed	4
Support Specific Project	2
Process Improvement	2
Reduce Logistics Costs	1
Support Partnersshipping	1

None of the participating organizations reported any difficulty in justifying the decision to proceed. Senior management generally concurred with the justification provided. However, the more complex and expensive development efforts took place as a result of a larger initiative aimed at improving customer service in two organizations, or developing a new cost system in five organizations. One organization reported their ABC system had evolved over time, and although complex and sophisticated in its current form, had not required justification.

Issue: Expertise of ABC Project Leaders

Findings:

The project leaders for ABC implementation typically received only limited formal training before initiating the ABC project. Two of the ten organizations hired individuals with previous ABC system experience. One of these firms employed an individual within corporate finance. The other hired an individual as an independent contractor. The project leaders for the remaining eight firms received their initial training primarily through a seminar held by a consulting firm specializing in ABC. The seminars typically lasted one week or less. The project leaders relied on books and several journal articles, principally from *The Journal of Cost Management*, to supplement their training. One project leader also reported having researched ABC while studying as an MBA student.

The project leaders did not view their limited training as detrimental to implementing ABC or leading the project team. Eight of the project leaders had financial backgrounds or education and found ABC a relatively straight forward concept. The other two project leaders did not have financial experience. One project leader had worked for another firm and had considerable experience with applying and implementing ABC. The other project leader had primarily a distribution background; however, he had an

accountant as one of the principal participants on his project team.

**Issue: Benefits of the Activity Analysis**

**Findings:**

The firms reported mixed results regarding the benefits achieved by performing an activity analysis. Nine of the firms performed an activity analysis; however, five firms did not report any significant finding as a result of the analysis. Four of the firms reported "significant" results from performing an activity analysis. The results identified and eliminated nonvalue-added activities consuming a large amount of logistics resources. One firm reported that ". . .the activity analysis alone justified the entire ABC effort." The case studies concentrated on the management processes affected by ABC and did not discuss actual cost data to gain access and to avoid confidentiality problems. As a result, the dollar savings resulting from the elimination of nonvalue-added activities were not available.

Five of the firms reported no significant benefits resulting from the activity analysis. They attributed the lack of benefits to previous initiatives which may have identified any major significant process changes. The five firms had active TQM or continuous improvement initiatives

underway, and they had already analyzed their major processes for nonvalue-added activities.

Nine of the firms reported that they considered activity analysis as a beneficial and required action. The analysis provided a total mapping of the logistics processes. Other initiatives mapped only portions or a limited number of processes. They also reported gaining greater insight into the work actually performed at lower levels within the organization, and the analysis enabled them to better understand how to develop the cost drivers for the activities and how the activities consumed overhead resources.

Issue: Use of Consulting Firms

Findings:

Seven of the firms used consulting firms or outside contractors during the initial stages of ABC implementation. The firms had become aware of ABC through journal articles or professional conferences. The consultants provided the training required for the project team to become familiar with the ABC concept and to understand the steps required for implementing an ABC system.

Three of the firms elected to use a consulting firm or outside contractor beyond the problem definition stage. One firm used a consulting firm as an active participant in the implementation effort. The consultants provided the initial

training but performed the same functions as corporate and plant team members during the remainder of the implementation effort. The company did use the consulting firm's software. The second firm limited its use of a consulting firm to initial training and software support. The third firm used an outside contractor to develop a specialized ABC model for the order fulfillment process to evaluate the impact of EDI and partnershiping.

Seven of the firms did not use consultants beyond the problem definition stage. The firms reported that they had sufficient in-house resources and expertise available to develop the model. They also believed they could gain more benefits by performing the analysis themselves. The seven firms all indicated an in-house analysis enabled them to gain greater insight into their business processes, the consumption of resources by activities, and their cost system. The firms reported the major disadvantage from not using a consulting firm was the lack of benchmarking capability. They could not compare their approach, model, or results against those developed by other firms.

Issue:      Impact of the Human Factor on Success of ABC  
                 Implementation

Findings:

Eight firms reported that the importance of the human factor regarding the implementation of their ABC systems. The human factor consisted of obtaining a "buy-in" to ABC



from management and the workforce. The firms contended that their systems would not have proven successful without obtaining "buy-in" during each stage of the implementation process. One firm partially attributed a less than successful ABC pilot to their lack of understanding of how the labor force would impact ABC implementation.

Management "buy-in" to ABC played a particularly critical role during the problem definition stage. The ABC "champion" or project leader had to sell management on the benefits of ABC and explain the potential implications resulting from shifts in cost allocations. ABC implementation required management "buy-in" for obtaining members for the cross-functional implementation team and permitting the implementation team to interview supervisors and workers. The firms reported management feedback as a necessary step for later gaining management acceptance of the ABC results and for developing credibility of the implementation process. None of the firms reported any problems with obtaining management "buy-in;" however, they cited extensive communications with other functional managers and representation from the functional areas on the implementation team as techniques for avoiding potential problems.

The operational stage also required "buy-in" from management. ABC implementation increased the logistics cost allocation for a small percentage of the brand or

division managers. Management support obtained earlier during the project helped to circumvent some of the potential objections. The implementation team provided additional explanations of the allocations to ensure support. One project leader stated the importance of management support:

"It is easy to 'trash' an ABC system. You can always find an exception where ABC may not have accurately measured the product's total cost."

The firms also reported the effect the workforce can have on ABC development. Perceptions of ABC as a workforce reduction tool could result in distorted time allocations, an inaccurate activity analysis, failure to identify nonvalue-added activities, and lack of support for follow-on improvement actions. The firms relied on communications to obtain worker support. They explained how ABC could eliminate waste and improve their competitiveness. One project leader noted that the interview process resulted in stronger support since the workers could demonstrate their expertise and identify areas having a negative effect on their performance. Another firm reported ABC had credibility with the workforce because it had identified many of the problems voiced by the workforce. The ABC analysis went beyond previous analyses by demonstrating what factors had driven the nonvalue-added activities and how they effected cost and performance.

Issue: Examples of factors influencing an unsuccessful  
ABC pilot study

Findings:

One organization reported experiencing an unsuccessful ABC pilot. The respondent considered the pilot as less than a success since the implementation team could not trace a large proportion of the indirect costs to the cost objects and the identification of nonvalue-added activities did not result in improvement action. Other factors such as the champion leaving the implementation team, poor site selection, unconstrained scope, and limited resources also contributed to the lack of success.

The implementation team could not accurately trace many indirect costs or resource categories directly to a cost object. The plant had many joint or common costs, and the project team could not identify any strongly correlated cost drivers. The team resorted to using percentages or volume-based drivers to allocate the costs. Labor frequently moved between different activities, and neither the cost system nor the project team could isolate the time labor spent performing specific activities. The team also found much of the cost data was not readily accessible or in a form usable by ABC.

The activity analysis resulted in the identification of several nonvalue-added activities; however, plant management acted on only a limited number. The workforce had a vested

interest in preserving their overtime hours due to retirement pay calculations rather than in eliminating nonvalue-added activities and reducing labor hours. The project team did not have workforce "buy-in" prior to implementation. Plant management also did not possess the resources needed to support a continuous improvement effort, and several actions identified by the ABC pilot would have required additional funding to implement.

Several other factors affected the pilot's results. The corporate "champion" initially played a major role in selling ABC and obtaining the resources required for the pilot. During the implementation process, the champion left the logistics organization due to a promotion, and the organization did not replace the champion. The lack of a champion constrained the resources, time, and access to the corporate staff needed by the project team. The firm selected the pilot site based on its proximity to the corporate office. The site selection decision did not consider whether ABC could work in the plant environment and sufficient cost data existed to support an implementation effort. The pilot also had too broad of a scope. The firm's initial ABC pilot tackled an entire plant with numerous processes, and the respondent indicated they could ". . . never get their arms around the entire operation." Limited resources and time precluded the team from fully mapping or understanding the plant's operations.

Other Findings Regarding ABC System Design:

Issue: In-house versus vendor ABC software

Findings:

The majority of the researched firms used in-house programs rather than vendor software specifically developed for ABC. Eight of the ten firms reported using in-house spreadsheets or databases as their ABC systems. Two firms used vendor developed software.

Eight firms elected to use in-house programs as their ABC system. Four reported having explored commercial ABC software but found the software, "too expensive," "constraining" or "unsuitable" for their particular application. Two of the four cited the need for additional software training as another reason for not selecting commercial software. The eight firms reported being satisfied to being highly satisfied with their systems.

In-house software systems varied widely in sophistication and hardware requirements. Three firms developed extensive relational databases on mainframe computers. The databases received transaction level updates from interfacing financial systems on a routine basis. Logistics and financial analysts could directly interrogate the database or extract portions for use with a spreadsheet program on a personal computer. The mainframe systems offered the greatest ability to produce detailed reports by product, customer, mode, or general ledger account. Five of

the firms relied on off-the-shelf PC-based spreadsheet programs. Interlinked spreadsheets enabled these firms to trace costs and produce reports on almost the same scale as the mainframe computers; however, PC-based programs generally had a smaller scope, were limited to diagnostic applications of ABC, and provided only periodic updates.

The two firms using commercially developed ABC software used the software principally due to their relationship with a consulting firm. They elected to use the software developed by the consulting firm providing initial training or performing follow-on work. The firms reported being satisfied with the software, and they could generate the reports and costs required by management.

Issue: Use of activity-based budgeting

Findings:

None of the firms had used their ABC systems to develop activity-based budgets. Turney [142:175-178] has recommended using the activity costs to prepare budgets based on projected sales. ABC could use the sales data to determine activity volumes and the amount of resources required or cost incurred. One of the responding firms indicated they had used ABC for "targeting" or goal setting. The firm used "targeting" to establish cost objectives based on predicted sales or production volumes. They had used an ABC analysis to predict how costs would vary by sales or

production level. Another firm had only explored the idea of activity-based budgeting; however, they had other, higher priority efforts underway for their ABC system. One firm reported that they had no intent to expand ABC into budgeting, and they wanted to move away from the budgeting process. The remainder of the firms considered activity-based budgeting as likely future development; however, they had not made any plans to move towards implementation.

Other Findings Regarding Performance Measures:

Issue:     The aggregation level of activities used for costing versus the aggregation level used for performance measurement

Findings:

Six of the eleven firms participating in the research reported an interest in expanding ABC for performance measurement. They indicated ABM would require more detail and less aggregation of activities than required for ABC. ABC had aggregated or combined many correlated activities into macro activities to simplify the model and eliminate correlated activities or cost drivers. ABM would require additional detail or less aggregation to permit performance measurement at the responsibility level. The six respondents interested in ABM indicated they would require measurements at the responsibility level to develop performance measures for individual workers and their supervisors.

The firm using ABM and the two government organizations reported significant differences between ABC and ABM in the number of activities tracked for performance measures. One firm used 40 activities to fully assign or allocate costs to the cost object; however, the firm used nearly 200 activities for performance measures. The two government organizations used 120 and 80 activities respectively for costing purposes but expected to track nearly 400 separate activities for performance measurement. Their ABC systems included a much larger workforce, over 2,000 employees at each site, and a more diverse range of functions than the nine businesses participating in the research. The other three firms had not explored whether ABM would require the disaggregation of their macro activities for tracking purposes; however, they anticipated a significant increase in the number of activities required for ABM.

#### Summary

Chapter Four has presented the results of the site visits and personal interviews with the participating organizations. The research includes several findings regarding the effect of size, centralization of the logistics organization, and implementation methodology on the ABC implementation process and logistics decision-making and performance measurement. Several other findings resulted from the responses to questions contained in the



interview protocol regarding ABC implementation, design, and performance measurement. Chapter Five presents the conclusions drawn from these results.

## CHAPTER V

### SUMMARY AND CONCLUSIONS

#### Introduction

Chapter Five summarizes the research and presents the conclusions and implications drawn from the study. The chapter consists of five sections. The first section reviews the research objectives and methodology. The second section reviews the propositions, reviews the findings obtained during the research, and reports the resulting conclusions. The third section draws conclusions regarding the research methodology. The fourth section presents the managerial implications of the research. The final section provides recommendations for future research of ABC applications within logistics.

#### Section I Research Summary

The research had the objectives of determining how ABC impacted logistics decision-making and performance measurement, changed the reporting and allocation of logistics costs, affected the relationship between logistics and other functions internal and external to the firm, and was implemented within logistics organizations. ABC

applications initially occurred in a manufacturing environment [120:9], and most documented applications have only occurred during the past ten years [29:33]. ABC appears compatible with and potentially beneficial for services such as logistics [126:42] [23:15] [124:14]; however, the effect of ABC on the logistics organization and decision-making remains undocumented.

The primary purpose of the research focused on determining and documenting how ABC has effected the logistics organization. The specific questions addressed by the research included:

1. Why did the researched organizations implement an ABC system within logistics and/or expand implementation from elsewhere in the firm?
2. How can logistics organizations best plan and manage the ABC implementation process?
3. How does the transition from a conventional to an ABC system effect the reporting and allocation of logistics costs?
4. How did information obtained from ABC impact logistics decision-making?
5. How has ABC impacted the relationship of logistics to organizations internal and external to the firm?

The research examined four variables: size of the organization, implementation stage, organization of the logistics function, and effect on logistics decision-making and performance measurement. The size of the organization variable assigned the researched organizations into two

levels: small, less than one billion dollars in gross revenue, and large, gross revenue exceeding one billion dollars. The variable organization of the logistics function assigned the researched organizations to two categories: centralized or decentralized based on the level where logistics management, planning, and execution occurred. The stage of implementation variable had five assignment categories: problem definition, planning, data collection, design, and operational. The variable effect on logistics decision-making and performance measurement was measured on five dimensions. The dimensions included the total of logistics costs traced to the cost object, logistics performance measures, logistics decision-making, internal relationships, and external relationships.

The research was conducted through site visits and personal interviews with individuals of the organizations currently using or implementing ABC. The research criteria limited the site visits and interviews to logistics firms implementing or using an ABC system. The organizations selected represented the leading edge of logistics practice as well as a cross-section of the industries currently exploring potential applications of ABC. Documentation obtained from the researched organizations supplemented the information obtained during the personal interviews.

The information obtained from the site visits enabled a comparison and analysis of ABC implementation between the participating firms. The research employed qualitative analysis to code the information, identify categories and make connections between categories, validate relationships, and develop a framework to summarize and integrate the data. The summaries enabled the research to address the specific propositions and predicted directions of the study.

### Section II — Conclusions

The research presents the conclusions from two perspectives: descriptive and prescriptive. The descriptive conclusions present how the researched firms have implemented ABC and how ABC has impacted the logistics organization. Conclusions regarding the effect of ABC on the logistics organization resulted from the proposition findings and the other findings occurring during the research. The research also formulated several prescriptive conclusions addressing how firms should implement and incorporate ABC into their cost management, decision-making, and performance measurement systems. The prescriptive conclusions provide several guidelines for firms considering or implementing an ABC system.

## Conclusions Drawn from the Research Propositions

### Size of the Organization

The research examined two propositions addressing the size of the organization.

Proposition A1:       The size of the firm and organization of logistics will have no effect on the number and types of benefits reported by logistics personnel.

Findings:            Large firms with centralized logistics management did not report a greater number of benefits than reported by large firms with decentralized logistics management or by smaller firms.

#### Conclusions:

The proposition was accepted. The findings indicated that the benefits obtained through ABC implementation did not necessarily vary with the size of the organization and how it organized the management of logistics. Four conditions contributed to this result. First, most of the researched firms implemented ABC as a diagnostic tool rather than as a replacement for their cost management system. The diagnostic approach focused on identifying non-value-added activities and areas of cost cross-subsidization. As a result, the firms had comparable implementation processes and reported similar results from their systems. Second, the oldest ABC system examined was two years old. The respondents indicated they had not analyzed all of the information provided by their ABC system nor had they exploited many of the cost reduction or process improvements

identified during implementation. Third, seven of the ten firms had completed only pilot implementations of ABC. The respondents anticipated ABC would provide a larger number and wider range of benefits when expanded into other areas, logistics and non-logistics, within the firm. Fourth, all of the firms experienced high product or customer diversity. The firms used ABC to address the cross-subsidization problems resulting from product or customer diversity. ABC implementations within these firms again produced similar numbers and types of benefits. Despite these conditions, the size of the firm and organization of logistics management did not appear to effect the number and types of benefits experienced by a firm implementing ABC.

Proposition A2:       The size of the firm will have no affect on the length of time required to implement an ABC system.

Results:               The time required for implementing an ABC system did not vary by the size of the firm.

#### Conclusions:

The proposition was accepted. The time required for implementation of an ABC system did not vary with the size of the firm. The results also supported the experiences previously reported by Turney [142:236] and Cooper [29:33] within manufacturing firms. They found most ABC implementations required from three to four months.

Eight of the researched firms had completed implementation by the time of the site visit. One firm reported a gradual evolution towards ABC and reported only the incremental time required to make software changes for capturing and reporting activity costs. Five of the firms had implemented ABC as a diagnostic tool and reported implementation times similar to those found by Turney and Cooper. Two firms reported implementation times of eighteen months or greater; however, these firms implemented the two most sophisticated systems examined during the research. The longer timeframes for more sophisticated systems supported the views expressed by Turney [77:236] and Brausch [17:44]. They suggested the time and cost of implementation would vary according to the complexity of the ABC system.

The size of the firm did not effect the implementation times reported by the examined firms. Other factors such as the sophistication of the ABC system appeared to have a greater effect on implementation than the size of the organization.

#### General Conclusions Regarding Size of the Organization:

The size of the organization did not act as a discriminating variable during the research. The benefits obtained from ABC and implementation timeframes appeared to be more closely tied to the objectives of the firms for ABC implementation and the level of sophistication or complexity



employed. Size could become a more discriminating variable as the firms expand ABC beyond their pilot programs to include other functions.

### Organization of the Logistics Function

The research examined two propositions addressing how the firms organized logistics management. The first proposition examined how the size of the firm and organization of logistics management effected the complexity and sophistication of the ABC system. The second proposition addressed whether the size of the firm and organization of logistics management affected the use of ABC information.

**Proposition B1:** The size of the firm and organization of logistics management will have no affect on the complexity, measured in cost drivers and activities, and the sophistication, determined by the size and the frequency of cost and activity updates, of the ABC system.

**Results:** Large firms with centralized logistics management implemented more complex and sophisticated ABC systems than other large or small firms.

### **Conclusions:**

The research rejected the proposition. Large firms with centralized logistics management did implement more complex and sophisticated ABC systems than the other researched firms. The findings indicate large, centrally managed firms within the study required a more complex and

sophisticated system to address the problems posed by product or customer diversity and to satisfy their cost management requirements. All of the large firms with centrally managed logistics reported an implementation objective of developing a new cost system. The firms used a greater number of cost drivers to capture more detailed cost data. The firms also used more sophisticated systems to support ABC. Two used relational databases updated on a near "real-time" basis and the third used a commercially developed software package. One small firm developed an ABC system as complex and sophisticated as the large, centrally managed firms; however, the system occurred primarily as a result of the hardware and programming capabilities within the firm and the need to handle a large amount of transactional data.

**Proposition B2:**      Size and centralization of logistics management will have no affect on whether the firm adopts ABC as a cost management system or uses ABC as a diagnostic tool.

**Results:**              Large firms with centrally managed logistics used ABC as a cost management system, and the other researched firms used ABC principally as a diagnostic tool.

#### **Conclusions:**

The research rejected the proposition. Large firms with centrally managed logistics implemented ABC to replace their previous cost systems. The small and other large

firms principally used ABC as a diagnostic tool. The results indicate that large centrally managed firms implement ABC to address the problems posed by diversity and to eliminate cross-subsidization or "averaging." The respondents indicated that their previous cost systems did not adequately address the problem and seriously distorted the logistics overhead costs allocated to specific brands or divisions. Accurate allocations of logistics overhead costs were cited by these firms as part of the justification for replacing their previous cost management system. Two of the three large centrally managed firms had replaced their previous cost management systems with ABC. The third implemented ABC with the intent of developing a new cost system but did not proceed due to problems experienced during the pilot program.

The seven small and other large firms used ABC principally as a diagnostic tool. Periodic "snapshots" of ABC information satisfied their requirements for prioritizing improvement actions, supporting continuous improvement, and providing the accurate cost data required for logistics decision-making. None of the seven firms reported any plans to replace their cost management system with ABC.

### General Conclusions Regarding Organization of Logistics

The variable, organization of logistics, when coupled with the variable, size of the firm, provided a basis for understanding why the researched firms designed and employed their ABC systems for different purposes. Large, centrally managed firms required more sophisticated cost management systems to gain greater control over logistics costs and to obtain greater accuracy in cost allocations to brand or division managers. The other researched firms developed less sophisticated ABC systems to provide management with periodic updates of logistics costs and to focus continuous improvement or logistic decision-making on areas with the largest potential payback.

### Implementation Stages

The research used three propositions to examine the implementation process. The first proposition concentrated on the implementation methodology used by the researched firms. The second proposition focused on identifying the stages where the researched firms encountered the most impediments during implementation. The third proposition examined how customer and product diversity impacted design considerations during ABC implementation.

Proposition C1:       The methodology employed for implementing ABC will not vary by the size of the firm.

Results:               The researched firms used similar methodologies for implementing ABC and progressed through the five implementation stages.

Conclusions:

      The research accepted the proposition. The size of the organization had no impact on the implementation methodology employed by the firm. The result also appeared consistent with the earlier conclusions reached regarding the effect of size on implementation times and benefits.

      All of the firms followed the same sequence of steps during ABC implementation. The researched logistics organizations employed the same methodology used in manufacturing without modification. The findings supported the five implementation stages identified in Table Four and the sequence of actions recommended by Brimson [18:58-59], Turney [142:261], and Cooper [30:78]. None of the firms reported any modifications to the methodologies recommended by these authors. The respondents supported the methodology and found all of the steps necessary for fully understanding the variety of activities accomplished, identifying non-value-added activities, and for developing cost drivers with a causal relationship.

The findings also indicate most firms perceived and implemented ABC as a new project or initiative. Nine of the ten firms had clearly defined ABC programs and passed through the five implementation stages shown in Table Four. One of the researched firms reported a gradual implementation of ABC over a ten to fifteen year period. Their cost system had evolved over time and incorporated many of the same techniques and concepts included in ABC. They did not develop ABC as a special project. The requirement for more accurate cost data caused their cost system to eventually evolve into an ABC system.

Proposition C2:       The number of major impediments, measured in number and type, will not differ by implementation stage.

Findings:            The number of impediments reported by the researched firms did vary by stage. The firms reported encountering the most impediments during the data collection and design stages.

#### Conclusions:

The research proposition was rejected. The results indicated the firms encountered the most impediments during the data collection and design stages of implementation. The findings differed from the prediction that the firms would encounter more impediments during the problem definition and design stages.

The researched firms did not report as many impediments during the problem definition stage as anticipated. The respondents indicated senior management supported ABC as a means to obtain more accurate costing and to identify continuous improvement opportunities. One firm reported ABC as "prejustified" due its ability to provide more accurate costs and to demonstrate causal relationships for overhead costs.

The firms encountered many of the impediments during the design stage such as those identified by Cooper [33], and MacArthur [103:40]. The respondents indicated several problems regarding the level of detail or aggregation in the model, whether to trace or allocate fixed costs, the selection of cost drivers with an ability to demonstrate a causal relationship, and the number of cost drivers to include in the model.

Data collection emerged as the stage where the researched firms encountered the largest number of impediments to implementation. The responses indicated logistics cost data did not exist in a form readily usable for ABC. The finding supports the conclusions drawn in earlier research that cost management systems used in transportation and warehousing did not provide distribution [logistics] managers with the cost information needed to effectively manage their operations [55] [56] [96]. The respondents relied extensively on interviews to trace the

costs of logistics resources to specific activities. The respondents reported logistics overhead had typically been allocated using a volume-based driver.

Proposition C3: Customer and product diversity will have no effect on the complexity and design of the ABC system.

Findings: The researched firms primarily designed their ABC systems to capture the effect of product diversity.

#### Conclusions:

The research proposition was accepted. The findings indicate the researched firms designed their ABC systems primarily for product costing. The ABC systems within six of the ten firms enabled a break out of logistics overhead costs by product. One design only permitted a break out of costs by customer. Three ABC systems possessed the capability to determine product and customer profitability.

Two factors contributed to the product focus within the researched firms. First, logistics applications have experienced a "carry over" effect from manufacturing applications. ABC literature and most ABC applications within manufacturing focus on product costing. Logistics applications have followed the same approach and employed cost drivers focused on product costing. The product orientation had enabled a more accurate allocation of logistics costs by brand or product division. Second, ABC applications within logistics have focused on internal cost



control. The firms have used ABC as a "diagnostic tool" for targeting non-value-added activities, prioritizing improvement efforts, and obtaining more accurate cost data for cost trade-off analyses.

ABC systems with an ability to trace logistics overhead costs to specific customers have appeared as an emerging trend within the researched firms. Nine of the ten firms reported high diversity in the demands placed by customers on their logistics system. Seven respondents also indicated a requirement to accurately capture the costs of quick response and just-in-time relationships for determining customer profitability. However, only four of the nine firms possessed or were developing a customer costing capability. Three of the firms did not currently trace costs to customers, but one firm did indicate their system could provide the information with software modifications.

#### General Conclusions Regarding ABC Implementation Stages

The research supported extending the methodology used for implementing ABC in manufacturing to a logistics environment. Logistics implementations differ from manufacturing in the availability and accessibility of the cost data. As a result, logistics applications expended more effort during the data collection stage than experienced in manufacturing applications. Logistics implementations share the manufacturing focus on product

costing, but the effect of customer diversity has caused many logistics organizations to examine the capability of determining customer as well as product cost.

#### Logistics Decision-Making and Performance Measurement

The research examined six research propositions for addressing the effect of ABC on logistics decision-making and performance measurement. The propositions explored the logistics costs traced to the cost object, logistics performance measures, logistics decision-making, and the internal and external relationships of the researched firms.

Proposition D1:      ABC implementation will not influence logistics managers' perceptions of their ability to effect changes in the total cost of the cost object.

Results:              Logistics managers reported ABC increased their ability to manage and control logistics costs.

#### Conclusions:

The proposition was rejected. Logistics managers perceived ABC had increased their ability to manage and control costs. The factors contributing to the perception included more accurate information for cost trade-off analyses, increased visibility into the logistics processes, identification of non-value-added activities, and the capability to trace and establish a causal relationship between some logistics overhead categories and the services provided in support of products or customers. Six

respondents further cited cost reduction examples directly resulting from ABC implementation to support their position.

Proposition D2:      ABC implementation will have no effect on the organization's performance measurement system for logistics by tracking management action to changes in total cost of the cost object or to reductions in the volume of cost drivers.

Results:              Activity-based data has not been incorporated into the performance measurement systems of logistics organizations

#### Conclusions:

The research accepted the proposition. The research found only one instance where a firm had incorporated ABC results in its performance measurement system. However, six of the remaining firms reported plans to implement ABM at a future, unspecified date. ABM implementation appeared to be a potential future trend within logistics.

Several factors have contributed to the limited application of ABM within the researched firms. First, ABC applications within logistics represent a very recent phenomenon. The respondents suggested their firms needed to build more confidence in ABC before expanding into ABM. Second, ABM would require management and worker "buy-in" before implementation. The respondents believed "buy-in" would occur as a result of gaining more confidence in ABC and the non-financial information it produced. Third, ABM

would require more complexity and sophistication than currently available in all but two of the researched firms. ABM would require the tracking of a larger number of activities at the task level, and the firms would require updates on a more frequent basis. Fourth, ABM has also emerged within the last two to three years. Many of the firms only have had limited exposure to the concept and did not include ABM in their initial plans.

Proposition D3:       ABC information will have no affect on how the researched organizations manage the selection of members or the structure of the supply chain.

Results:               None of the researched firms had used ABC for managing their supply chain relationships.

#### Conclusions:

The research accepted the proposition. The research did not detect any logistics organizations currently using ABC data to manage or structure their supply chain relationships.

Three factors appear to have affected the ability of the firms to use ABC for managing supply chain relationships. First, the firms implemented ABC primarily to cost their internal processes. Three firms could break out logistics overhead costs by customer; however, none could break out costs by vendor. Transportation and freight costs represented the major supply chain activities tracked in the ABC systems. Eight firms tracked freight and

transportation costs in their ABC systems, but only three ABC systems tracked the information by mode and carrier and used the information for evaluating performance. Second, the firms reported that they wanted to drive down their internal logistics costs before expanding to supply chain management. Third, supply chain applications fell outside the initial scope of the ABC models. They did not include cost drivers and activities to trace their costs to specific vendors. The researched systems would require greater complexity and sophistication for supply chain costing.

ABC may eventually effect how the researched firms manage and select members within the supply chain. Nine of the firms indicated that their ABC systems needed to incorporate activities to track the performance and costs of conducting business with other firms in their supply chain; however, only six of the firms had begun tracking and tracing activity costs affected by other members within the supply chain. The firms planned to use the information for make or buy analyses and to compare alternate channel structures.

Proposition D4:      ABC information will have no affect on the number of contacts measured in volume and type, between the logistics function and other functions within the firm.

Results:              Contacts between logistics and other organizations increased following ABC implementation.

### Conclusions:

The proposition was rejected. ABC implementation increased the amount of contact occurring between logistics and other functions within the firm. The increased contacts resulted from changes in the allocation of logistics overhead costs, more accurate cost data to support cost trade-off analyses between logistics and other processes within the firm, the identification of the cost drivers for non-value-added activities, and the increased visibility regarding logistics contribution to product or customer profitability.

Proposition D5: ABC information will not change the performance evaluation by the researched organizations for other organizations in the supply chain.

Results: The research found logistics organizations had not implemented activity-based performance measures of other supply chain members.

### Conclusions:

The research accepted the proposition. The findings indicate only a small percentage of the researched firms used ABC for evaluating the performance of specific segments within their supply chain, and only six firms had plans for tracking cost and non-financial information regarding the performance of other supply chain members.

Current applications focused on measuring performance within specific segments of the supply chain. None of the firms had the capability to cost or track all of the activities associated with upstream vendors. Three of the firms reported using activities to track quality related costs such as inspection, returns, or reworks. Three firms tracked costs by customer. Three firms also used their ABC system to track carrier performance and costs.

The firms reported only limited applications of activity-based performance measures for supply chain performance due to several reasons.

First, the scope of their ABC system frequently did not provide visibility over total logistics costs. The scope of the ABC system generally approximated the scope of responsibilities for the distribution or logistics area examined. The ABC systems primarily concentrated on the outbound or distribution function of logistics, and only four of the ABC systems had sufficient scope to capture inbound costs such as order placement, expediting, and receiving.

Second, the majority of the firms used ABC as a diagnostic tool. Data collection and tracking precluded frequent analyses and evaluation by five of the firms. The diagnostic models concentrated on high cost areas with potential cost distortions and did not contain detailed information for all logistics functions. Firms with the

more sophisticated models had the capability to maintain the cost data and track the performance measures on a regular basis. The respondents with the sophisticated models indicated their firms had either planned or initiated action for tracking several performance measures.

Third, many of the firms did not initially consider measuring supply chain performance when implementing their ABC systems. The research identified only five firms which included supply chain measures during the initial design of their system. The remainder of the firms recognized the capability of ABC to provide the information following the development of their system.

Proposition D6:      ABC implementation will have no affect on the amount of logistics overhead assigned to the cost object – brand, product, customer, or supply chain.

Results:              ABC did effect the assignment of logistics overhead to the objects used by the researched firms.

#### Conclusions:

The research rejected the proposition. ABC changed the allocation of logistics overhead assigned to the cost objects used by the firms. However, ABC implementation did not evenly spread the changes across all items. The results supported the experience reported by Turney [142:5]. Cost assignments [allocations] dropped for products or customers with high volumes and low diversity [standard services] and



increased for products and customers with low volumes and high diversity [specialized services]. Cost assignments for the majority of products and customers did not experience a significant change.

ABC performed as anticipated within the researched firms. Cost allocations changed for only a relatively small proportion, less than twenty percent, of products or customers. However, the twenty percent usually accounted for eighty percent of the business of the researched firms. The cost allocations did change management perceptions regarding product and customer profitability.

ABC did not change the total logistics costs in any of the researched firms. Pendlebury and Platford [63] indicated total logistics costs may change as the firms uncover many of the hidden logistics costs, such as material handling, within the firm. The research did not obtain similar findings; however, future research may uncover similar circumstances as the firms expand the scope of their ABC systems. The researched firms limited their ABC models to specific departments or functions within the firm. As a result, the ABC models did not address logistics costs managed elsewhere in the firm, and total logistics costs did not change.

## General Conclusions Regarding Logistics Decision-Making and Performance Measurement

ABC did not have as major an effect on logistics decision-making and performance measurement as anticipated at the onset of the research. The major factors contributing to the limited effect of ABC include the recent implementation of ABC within logistics, the focused approach used in diagnostic models, and the limited scope of the ABC models.

ABC implementation represents a recent phenomenon within logistics. The oldest system examined was in place for approximately two years. The respondents indicate they have just begun receiving "usable" or "current" data from their ABC systems. As a result, they have just begun applying ABC data to many of their day-to-day management decisions. The respondents also stated that the users of ABC information did not initially understand the results, and the users required additional training to understand, accept, and apply the information. The process required for gaining management acceptance and application of ABC data had not been fully completed at any of the visited sites.

The focused nature of the diagnostic ABC systems limited the applications to management decision making and performance measurement. One half (five organizations) of the applications were defined as diagnostic. The systems tracked and collected data on an ad hoc basis to provide periodic snapshots of cost consumption and activity volumes.

The diagnostic systems generally had a very limited scope due to the labor intensive process of collecting the cost data. As a result, the systems addressed a relatively small range of logistics decisions or supported special projects. The information also did not provide sufficient detail on an ongoing basis to support either internal or external performance measures.

The ABC models included in the research generally addressed only a limited scope of logistics responsibilities within a firm. The definition used by the firms for logistics or distribution frequently limited the scope to the distribution function. Seven of the models did not capture the inbound or materials management function. None captured logistics costs within production such as materials handling or work-in-process inventories. The firms generally limited the scope of their systems to the internal activities controlled by logistics or distribution managers. As a result, the models had a strong product costing orientation. Few firms examined customer profitability, and none fully addressed vendor costing.

### Conclusions Drawn from the Other Findings

The research also developed conclusions from several other findings not specifically addressed in the propositions. The conclusions drawn from the other findings addressed the topics of ABC implementation, system design, and performance measures.

#### ABC Implementation

The research identified several findings relating to ABC implementation. The findings addressed the justification for an ABC system, the individual or function spearheading ABC implementation, expertise of the project leader, benefits of the activity analysis, use of consulting firms, effect of the human factor, and pilot site selection.

Cost avoidance or the use of cost-benefit analyses did not play a major role in justifying an ABC system. None of the firms used a cost-benefit analysis as their justification. They primarily justified ABC based on the need for more accurate logistics cost information or to support a larger umbrella project or initiative. Results obtained from the initial ABC questionnaire, Appendix D, supports this conclusion. Ninety-two percent of the respondents also did not use cost avoidance or a cost-benefit analysis to justify development of an ABC system.

Logistics played a major role in spearheading the development of ABC. Logistics managers spearheaded the majority, six, of the researched ABC systems. Finance or accounting led the development in three, and an executive group initiated action in one instance. The major force behind ABC within logistics generally came from the financial managers assigned to the logistics function. The case study finding differs from the results obtained in the initial ABC questionnaire, Appendix D. The questionnaire results indicated a much larger role by finance with logistics spearheading only twelve percent of the ABC implementation efforts.

The individuals leading the implementation of an ABC system do not require an extensive background in ABC. Eight project leaders had no prior implementation experience. The project leaders learned about ABC through seminars and exposure to ABC literature. The project leaders, with one exception, had an accounting or finance background. The project leaders' ABC expertise had no effect on the level of sophistication or complexity within the model.

The activity analysis did not prove as beneficial as initially anticipated. Authors such as Brimson [18], Turney [142], Rotch [124], and others indicate the activity analysis would produce significant benefits to the firm by increasing management insight into the activities and the identification of non-value-added activities. The results

indicate many of the firms had already obtained these same benefits through other TQM or continuous improvement initiatives. However, firms with no previous TQM or continuous improvement efforts did report major benefits from the activity analysis. ABC also expanded on the other programs by providing a total mapping of the logistics process.

The research indicates that the firms had sufficient in-house capability for developing an ABC system, and that the firms used consultants primarily in a training capacity. Nine of the ten firms developed and implemented their ABC systems from available in-house resources. The systems ranged from unsophisticated, table-top ABC analyses to very complex, sophisticated systems using relational databases and receiving real-time updates. The firms elected to develop ABC from internal resources to gain a better understanding of their business processes, obtain more cross-functional dialogue, and to gain greater insight into the costing of specific products and the activities consuming available resources.

The human element plays a major role in the success, or failure, of an ABC system. The researched firms emphasized the requirement to obtain management and worker "buy-in" to the system. "Buy-in" took place in the form of extensive communication and explanation of ABC, using a cross-functional implementation team, and discussing the results

generated from the ABC system. The firms indicated early "buy-in" streamlined their follow-on actions to obtain data, gain access to key managers, and gain management acceptance for changes in their logistics overhead cost allocations.

Pilot site selection played a key role in the success of the ABC systems. Six of the firms used pilot programs, and five reported successful pilots. The factors contributing to the success, or lack of success, included a limited scope, data accessibility, the ability to accurately break out joint or common costs, a receptive management and workforce, dedicated resources for the project, continuity of leadership, and the capability to act on potential improvements identified by the project team.

### System Design

The research developed two conclusions from the other findings affecting system design. The conclusions address software development and activity-based budgeting.

ABC systems do not require commercial software applications. Three of the firms developed sophisticated relational databases using in-house resources. Six of the firms used PC-based spreadsheet programs for their ABC systems, and only one firm used commercially developed software. None of the firms reported any problems with their software. Firms which explored commercial ABC

software found it expensive, constraining, and not adaptable to their specific purposes.

Activity-based budgeting has not received any use among the researched firms. Several indicated ABC could support budgeting based on projected sales figures; however, none of the firms reported any plans in this direction.

#### Performance Measures

Activity-based performance measurement systems require greater detail or less aggregation than required for costing. The firms indicated ABM implementation would require more detailed non-financial information than captured in their ABC system. The detailed information would support performance measurement at the task level. The ABC system tracked cost and non-financial indicators at the level needed to eliminate cost distortions. The respondents indicated ABC tracking occurred at a much higher or aggregated level than required for performance measurement. The firms would require more detailed information to trace the effect of worker or unit performance to the costs occurring at the activity level tracked by the ABC system.



### Prescriptive Conclusions

The research developed several recommendations based on the findings obtained during the site visits. The areas addressed include pilot use and selection, level of activity aggregation and using ABC as a diagnostic tool. The conclusions provide several guidelines for firms considering implementation of an ABC system. The research developed the prescriptive conclusions from responses to questions 3, 4, 7, 9, 10, 13, 16, 17, 18, 20, 25, and 26 in Part II of the interview protocol, follow on questions during the site visits, a review of the documentation received, and a review of the literature.

#### Pilot Use and Site Selection

Firms should initially implement a pilot ABC program. The case studies indicated the project team will go through a significant learning curve to understand ABC, perform an activity analysis, conduct effective interviews, and develop causal cost drivers. The pilot study appeared to reduce the subsequent time expended for implementing ABC.

The pilot study should provide an opportunity for the team members to learn about ABC implementation, should have a limited scope, and should ensure that the pilot site fulfills several criteria regarding data availability, workforce receptiveness, and improvement opportunities.

A pilot study provides an opportunity for the project team to learn about the implementation process, gain experience, and make mistakes on a small scale. The project team members frequently do not have much ABC training and have never implemented a similar project. The pilot allows the team members to perform each step of the implementation process, make modifications, and understand how the gathered information affects the accuracy of the ABC model. The team members gain valuable experience regarding the availability and sources of cost data, in performing an activity analysis, interviewing techniques, and in identifying and developing cost drivers. The pilot also minimizes the effect of making a mistake. The limited scope of the pilot prevents the team from compounding the error in multiple locations, ensures that less effort will be required for correcting the mistake, and allows the team to learn from the mistake and avoid duplicating the error in the future.

The pilot should address a limited scope of activities within a distribution center, warehouse, or other organizational division. Several case study firms used small distribution centers to pilot their ABC effort. The scope should be narrow enough allow the team members to fully understand the entire range of activities performed and how the activities interact. A large pilot project can initially overwhelm the project team and create delays in the overall implementation schedule.

Site selection for the pilot should fulfill several criteria. First, the location or function must have accessible cost data in a usable form. The pilot should provide the team with the opportunity to break out several indirect cost categories but should avoid activities with substantial joint or common costs. The team can develop techniques during the pilot to apply in more difficult situations during full implementation. Second, site management and workforce must be receptive to ABC. Management should communicate the intent of ABC and show how it can increase the competitiveness of the firm. During the interviews, a receptive workforce can provide substantial insight into the activities performed, the value added by the activities, and where waste occurs. Management support becomes important for releasing personnel for the interviews and for implementing any changes identified by the project team. And third, the site should have the authority to implement any improvements recommended by the team. Early success of the pilot to identify non-value-added activities, eliminate waste, and reduce costs will increase the credibility of ABC and build support for the overall project.

### Level of Aggregation

The case study firms identified the level of aggregation, or detail, as the major design issue confronted during ABC implementation. The level of aggregation represents a trade-off between cost accuracy and the cost to develop, operate, and maintain the ABC system. The following paragraphs discuss the concept of aggregation, describe the effect of aggregation on cost driver selection, and present several recommendations based on case study observations and available literature.

Aggregation refers to the roll-up or combining of smaller activities into a larger activity. Turney [142:126] refers to the aggregated or larger activities as macro activities. Aggregation frequently occurs during ABC implementation. The implementation team typically aggregates activities into macro activities to combine insignificant activities, reduce the number of activities tracked in the model and the subsequent costs for developing and maintaining the model, and simplify the ABC model and make it more understandable. However, over simplification of the model, or too much aggregation can also cause material cost distortion.

Aggregation at too high or macro of a level within the ABC model can result in cost distortion or aggregation error. Datar and Gupta define aggregation error as ". . . caused by aggregating heterogeneous costs.

Heterogeneity arises when individual products use different amounts of multiple resources (disaggregated costs). These differences are obfuscated by aggregation" [44:1]. The combination of heterogeneous activities into a single activity reduces the causality associated with the activity's cost driver. Kinard uses the concept of proportionality to describe the nature of causality.

Causality is defined as the property of the cost driver that, when the level of the driver increases (decreases), the cost pool level increases (decreases) proportionally. Proportionality is a condition which is seldom satisfied due to the presence of lumpy (indivisible) resources [89:3].

Cooper identifies three sources of cost distortion, or heterogeneity: product diversity, the relative costs of the activities aggregated, and volume diversity [33:35]. Combining activities affected by these factors will reduce the causality associated with the cost driver for the activity. As a result, aggregation not only affects the number of cost drivers used but which cost drivers to use [33:34]. Less aggregation [more activities] will allow for more highly correlated cost drivers, and greater aggregation [less activities] will result in less correlated cost drivers.

Observations made during the case studies resulted in the formation of several decision rules regarding the level of aggregation to include in the ABC system. The decision rules consider cost, diversity, and impact of the activity.

The decision rules begin with a single macro-activity for the entire model. The rules indicate whether to further disaggregate the activity into its components or sub-activities.

The cost rule has two major elements. First, the rule suggests that activities with low costs probably do not require further disaggregation. Further disaggregation will add more detail to the model, and the low cost of the activity will not seriously distort costing of the cost object. Second, the rule suggests aggregating the low cost activity with other low cost activities if they are approximately the same cost and are consumed in approximately the same proportion. The combination further simplifies the model and does not induce cost distortion if the activities are consumed in approximately the same proportion.

The diversity rule acts as a check for heterogeneity. The rule recommends further disaggregation if the cost objects consume the activity in disproportionate amounts. Disaggregation continues until the cost objects consume the sub-activities in proportionate amounts and a causal cost driver has been identified or the cost rule applies.

The impact rule includes three considerations. First, the rule recommends matching the level of detail in the ABC model with the cost information required to support management decision-making. Second, the rule suggests considering the impact further disaggregation will have on cost distortion. Aggregated activities with high total costs may not have a significant impact on unit costs after assignment to a large number of cost objects. Third, the rule recommends considering how further disaggregation will impact the desired level of accuracy.

ABC systems requiring highly accurate costs will probably require more disaggregation; however, most firms reported achieving a high level of accuracy after only disaggregating a limited number of activities.

The limited number of activities used in most of the case study ABC systems supported these decision rules. The typical ABC system for a distribution center used approximately 30 activities. The number will vary with the amount of diversity experienced and the functions performed.

#### ABC as a Diagnostic Tool

The researched firms employed ABC as a diagnostic tool rather than as a replacement for their cost management system. Five firms employed ABC strictly as a diagnostic tool. Diagnostic implementations of ABC covered a limited

scope of activities and occurred on a periodic or as-needed basis.

A diagnostic ABC system is the application of ABC solely for supporting process reengineering or identifying non-value-added activities. The diagnostic approach is a one time analysis of a business process, has a clearly defined and limited scope, and is not used for managing or assigning costs on an on-going basis. The firms used diagnostic ABC systems to quickly diagnose the activities performed in a process, the costs consumed by the activities or cost objects, and to focus and prioritize subsequent management action.

Diagnostic approaches required fewer resources than approaches using ABC as a cost management system. The diagnostic studies generally took from one to three months, required from one to six individuals, and required \$10-15,000 in travel, salary, and administrative expenses. The diagnostic approach followed the same methodology as required for larger ABC implementations but with several key differences.

First, the diagnostic application took a process perspective and focused on several macro activities of the organization or function under examination. The project team identified the activities consuming the most resources and experiencing the most diversity. Activities revealing



these characteristics became the focus for more detailed analysis.

Second, the project team conducted the activity analysis and designed the ABC model without leaving the corporate office. The project team used the experience and financial reports available within the corporate or headquarters office for identifying the resources, activities, and cost objects. The team contacted individuals at the corporate office with experience from the distribution center, plant, or function to determine how to assign resource costs to the activities and to develop causally related cost drivers. The team acquired any additional information through telephone contacts or by mail.

Third, the team performed extensive pre-site planning. The planning resulted in the development of a question set or survey to obtain the information needed to break down the high cost or high diversity activities. The pre-site planning also identified any tracking requirements. The team requested the site to track and provide specific activity information prior to their arrival at the site.

Fourth, the site visit concentrated on only the high cost or high diversity areas identified during the project team's macro ABC analysis. The survey and tracking data resulted in a further disaggregation of the macro activities and assignment of resource costs to sub- or micro-

activities. The team also performed several interviews with managers all the way up through the organization. The interviews asked questions regarding the future direction of the firm or site. The project team then determined the information the firm or site would also require to support the future direction. The site visits lasted approximately three to five days.

Fifth, the project team prepared a final report or workplan similar to a consultant proposal. The final report identified the sources of diversity and cost distortion, the cost drivers in the high cost activities, and any non-value-added activities with recommendations for their elimination or reduction.

The firms using ABC as a diagnostic tool reported several success stories and have continued their application. Benefits ranged from reducing the number of SKUs produced, eliminating non-value-activities such as unnecessary packaging or labeling, providing more accurate information regarding product and customer profitability, and focusing marketing and advertising on the regions and products with the greatest profitability.

### Section III — Research Methodology

The research used a questionnaire and eleven case studies to obtain the information discussed in the findings and conclusions. The methodology employed in the research led to the development of two conclusions. The first conclusion addresses the response rates obtained from the initial ABC questionnaire and two related surveys addressing logistics costing. The second conclusion addresses the techniques used to obtain access to the case study sites.

#### Questionnaire Results

The research methodology initially employed a questionnaire examining ABC applications within logistics, Appendix A. The questionnaire had the objectives of determining whether any leading logistics organizations had implemented an ABC system and exploring whether sufficient interest in ABC existed within logistics to merit continued research. The surveyed firms included the firms on the leading edge of logistics practice.

The limited objectives of the ABC questionnaire permitted the development of a short, concise survey instrument. The questionnaire was constrained to 20 questions on one sheet of paper. The questions focused on ABC implementation and logistics decision-making processes and did not request any cost information. The recipients were told all responses obtained from the research would

remain confidential. The research imposed these constraints to reduce the completion time, avoid any non-disclosure issues, and to increase the response rate.

The mailing included 100 large corporations possessing a vice-president logistics or distribution title. A cover letter accompanied the questionnaire indicated sponsorship from The Ohio State University. The survey produced only 22 usable responses, or a 22 percent response rate. Ten of the firms indicated an interest in participating in the research; however, only three of the ten actually participated as case study sites.

Two subsequent surveys exploring ABC use within logistics also produced low response rates. The Warehousing Education Research Council (WERC) and the Logistics Research Group from The Ohio State University surveyed the WERC and CLM membership regarding current and future practice within warehousing. Appendix E contains extracts from the survey results. The survey consisted of a detailed eight page questionnaire addressing various aspects of warehousing including a section addressing cost allocation and ABC use. The survey produced an overall eleven percent response rate.

A second questionnaire was mailed to determine the sophistication of the cost management systems used by major logistics firms. The survey was again limited to a single sheet to increase the response rate. However, the first page of the questionnaire requested written responses to

four hypothetical questions. Appendix F contains the questionnaire. The mailing included 245 corporations possessing a vice president of logistics or distribution position. A cover letter also indicated sponsorship from The Ohio State University. The survey resulted in 13 responses with 11 considered usable. Appendix G contains the survey results. The survey was later excluded from the research since the measurements fell outside the scope of the research and due to the low response rate.

The low response rates appear to have resulted from two conditions: the confidentiality of cost information and the competitive advantage resulting from the use of ABC. Confidentiality of cost information played a major role in responding to the ABC questionnaire. The respondents indicated they would not have returned the survey if it had requested any cost information. Several stated very early in the telephone conversation that they could not provide any cost data. All of the respondents insisted the names of their firms remain anonymous. However, the respondents generally became more open and expressed a willingness to share information regarding their implementation and use of ABC.

Firms using ABC also considered ABC as a competitive advantage. The respondents stated their participation in the research and survey remained contingent on the requirement for total confidentiality. They view ABC as

competitive advantage and did not want the competition aware of the respondents' use of ABC. The respondents also indicated some hesitation in responding to the survey due to the sensitivity and confidentiality of their cost information.

Contacts with the case study organizations throughout the research supported these conclusions. The research included eight organizations located through personal or professional contacts. Six of the eight required total anonymity before agreeing to participate. The six considered their use, or non-use of ABC, as confidential. Two government organizations also participated in the study and did not require confidentiality.

#### Case Study Results

Confidentiality also posed a major impediment to gaining access to the case study organizations. The research employed several techniques to overcome the confidentiality barrier, and eleven organizations agreed to participate in the study. The techniques included a process versus cost focus, anonymity of case study firms, immediate telephone follow-ups on potential leads, periodic telephone contacts, mailings, and sharing of research results.

The research avoided the confidentiality of cost information problem by taking a "process" rather than a "cost" focus. The initial telephone contact with the

respondents explained the research would not request any cost data from the firm. Instead, the research focused on the ABC process — how the firm implemented ABC and its application to logistics decision-making and performance measurement. The process focus eliminated the major impediment for obtaining approval for five of the firms.

The researcher agreed to keep the names of the firms confidential to avoid identifying specific companies as an ABC user. The government organizations did not require this agreement; however, eight of the other nine organizations required the anonymity. None of the firms required the signing of a nondisclosure form.

Potential leads received an initial telephone call as soon as identified through a faculty or professional contact. The immediate follow-up ensured the contact recognized the researcher's name and the purpose of the study. The initial contact frequently referred the researcher to another individual within the firm. The follow-up reduced the time between identification and directly working with the primary focal point.

The research used periodic telephone contacts to maintain respondent interest. The research identified four participants approximately five months prior to the site visits. The periodic telephone calls provided several benefits for the research. First, the respondents learned more about the research and its focus. Second, the

researcher developed a rapport with the respondents and gained a wider knowledge of the firms and their use of ABC. And third, the respondents used the time between the contacts to respond to any of the researcher's questions and to prepare for the site visit.

The research used several mailings to continue interest and answer respondent questions. The mailings included the questionnaire results, a summary of the ABC concept, and an ABC bibliography. Several respondents received ABC articles in response to specific questions or general interest areas such as ABM. The materials mailed also provided a form of pay-back for the time expended by the respondents during the case studies.

The respondents will also receive the results of the research. The participants requested the feedback to benchmark their ABC systems and approaches against other leading firms. Most of the participants received little training on ABC, and they requested the feedback to determine how to improve their analyses, incorporate ABM, and better apply ABC to logistics decision-making.

The steps taken to overcome the confidentiality issue and obtain approval for participation in the case study resulted in eleven firms participating in the research. The participating firms provided several hours to several man-days usually at the vice-president or director level. The rapport and prior conversations enabled several very candid



and revealing discussions to occur regarding the techniques and applications of ABC.

#### Section IV — Implications

The results and findings of the research have implications for logistics practice and cost accounting within the organization. The implications for logistics practice address the implementation and future applications of ABC within logistics. The implications for cost accounting focus on logistics costing and the role of logistics financial managers within the organization.

##### Implications for Logistics Practice

The research has four major implications regarding the implementation and future direction of ABC within logistics practice. First, ABC will experience continued growth within logistics throughout the 1990s, and logistics managers must determine whether to implement ABC within their organization and the effect ABC will have on the logistics function. Second, ABC applications vary in complexity and sophistication, and logistics managers must select the ABC system which satisfies their needs and the needs of their customers. Third, the research suggests logistics organizations implementing ABC subsequently plan to implement ABM for evaluating logistics performance. Logistics managers must determine how to employ activity-

based performance measures for process improvement as well as the effect ABM will have on the logistics organization. Fourth, the research indicates logistics organizations will eventually apply ABC to supply chain management, and logistics managers will need to assess how ABC can improve supply chain competitiveness and how to use ABC for evaluating supply chain performance.

#### Implementation of ABC in Logistics

ABC will experience continued growth in logistics management during the 1990s. The ABC questionnaire, the WERC/OSU survey, and the case study analysis revealed a movement toward the expanded use of ABC for supporting logistics decision-making. The nature of logistics decision-making has become increasingly complex due to the direct effect of logistics on corporate profitability and on the costs of performing other functions within the organization, the number of options requiring consideration by the logistics manager, and the influence of numerous factors external to and beyond the immediate control of the organization. Logistics managers require more accurate and precise cost data to make better and more timely decisions, and ABC has emerged as a mechanism to provide the cost information needed for making better logistics decisions.

The growth of ABC applications within logistics has major implications for logistics managers. ABC will increase the visibility of logistics costs throughout the entire value chain, and organizations will place greater emphasis on reducing logistics costs. Logistics managers will confront cost trade-off issues extending beyond their functional responsibilities and will play a more active role in decisions affecting production and marketing as well as the structure of the supply chain. Senior managers will have more visibility regarding how logistics decisions affect overall profitability, and logistics managers will be more accountable for the effect of their decisions on product or customer profitability.

Logistics managers will need to determine whether their firm will benefit from implementing ABC within logistics. The decision regarding ABC implementation should be based on whether significant diversity exists in how products or customers consume logistics resources and whether the diversity seriously distorts cost allocations. Logistics managers must also consider whether ABC will provide a more thorough understanding of how logistics decisions effect total product cost and will identify opportunities for reducing costs.

Organizations considering ABC within logistics can adopt one of the following two strategies. First, the organization can employ an outside change agent to assess

whether the current cost accounting system has seriously distorted costs and whether ABC can provide more accurate cost information. Second, the organization can develop a diagnostic system for evaluating the effects of diversity and comparing the results of the current cost system to ABC.

The outside change agent strategy enables the firm to more quickly evaluate the effect of ABC without expending substantial internal resources. The consulting and public accounting firms have in-place expertise and can accelerate the change process. The organization does not have to form and educate a project team, collect and analyze the cost data, or develop or design an ABC system. Instead, the outside change agent provides the expertise required for designing the ABC system and has the experience needed for quickly collecting and analyzing the cost data. This strategy also enables the firm to observe and learn more about ABC from the change agent.

The strategy does have several disadvantages. Eight of the case study firms did not use outside change agents for implementing ABC and identified the following reasons. The outside change agent performs many of the key planning and design functions, and the organization does not develop a core of ABC expertise. The lack of expertise precludes the organization from understanding the ABC system, the cost assignment process, the assumptions made by the change agent, and actively participating in the subsequent

development of an ABC system. The eight case study firms also indicated that outside change agents had a "vested interest" in developing the ABC system and obtaining follow-on work for software development and process reengineering.

The diagnostic strategy concentrates on examining the effects of diversity on costing and on comparing ABC with the current cost accounting system. The approach differs from the previous strategy by relying on the internal resources of the organization to perform the analysis and focusing on activities exhibiting some form of diversity.

The diagnostic strategy follows the same sequence of actions shown in Table 4; however, the actions focus on areas where the effects of diversity may seriously distort costing. The initial steps of the strategy include a careful defining the project scope and the identification and training of the project team. Many of the case study firms used consulting firms for the initial training.

The project team develops the diagnostic ABC model by performing an activity analysis and tracing resource costs to the identified activities. The activity analysis would occur in two steps. First, the project team would analyze the logistics processes, identify activities, and trace resource costs to the activities. The analysis would draw upon the experience readily available to the project team. The team would then concentrate only on those activities where diversity in product or service characteristics could

seriously distort costs. Second, the team would conduct site visits to perform an in-depth examination of the activities exhibiting diversity and to interview the personnel performing the activities. The project team would develop additional activities and cost drivers to account, as needed, for any diversity.

The diagnostic strategy is completed by comparing the costs assigned by the current cost accounting system to those provided by the diagnostic ABC system. Serious undercosting or overcosting may indicate the need for an ABC system. Logistics managers should compare the results to determine whether ABC provides any additional insights into the costing of specific logistics activities or how logistics costs effect product or customer profitability. The insights and the ability to pinpoint specific activities for reengineering may alone justify further development of a more detailed ABC system.

The diagnostic strategy also has several disadvantages an organization should consider before implementation. The development and analysis of a diagnostic system will require dedicating two to three key individuals from several functional areas for several months to the project, and the cost and time required for the project will vary with the scope and amount of diversity encountered. The analysis will require a more time due to the added requirements of training and forming the project team. The project team may

encounter more complex costing situations such as the handling of joint or common costs, and the team members must frequently learn more detailed ABC techniques while actually performing the project. The organization will have no means for benchmarking the results or the diagnostic model against approaches taken by other organizations.

### Complexity and Sophistication

The case study research and the initial questionnaire indicate ABC can take many forms. ABC systems span a continuum from the traditional cost model using a unit-based cost driver to a very complex system with numerous activities for costing virtually every task performed by the organization. The complexity and sophistication of the ABC systems depends primarily on the amount of product and customer diversity confronting the organization. Many organizations have already implemented limited forms of ABC system to address the problems posed by diversity; however, the organizations have generally not associated their actions with ABC. The use of multiple allocation bases and costing at an activity level indicate an evolutionary movement in logistics towards the expanded use of ABC.

The effect of customer diversity and the centralization of logistics management also have implications regarding the complexity and sophistication of ABC systems. The case study firms initially designed their ABC systems to track

the effects of product diversity. The research results suggest most firms will increase the complexity of their ABC systems to also track the effects of customer diversity. Organizations found the high diversity in the demands placed by customers on their logistics systems seriously distorted reports of customer profitability.

The size of the organization and the centralization of logistics also effected the complexity and sophistication of the ABC system. Large, centrally managed organizations generally experienced more diversity than their counterparts and implemented more complex and sophisticated ABC systems to handle the diversity. These firms also required greater accuracy in assigning logistics "overhead" to their customers, the brand or product divisions. The organization also implemented more sophisticated ABC systems due to a requirement for more timely cost data and for the ABC system to interface with the other financial and transactional systems maintained by the organizations.

The ABC system selected represents a series of trade-offs between the cost of obtaining and tracking activity information and producing a more accurate assignment of logistics cost. Logistics managers will require a greater understanding of ABC to properly design the ABC system and understand the signals ABC sends. Design of the ABC system will affect the quality of the cost information used in making key logistics decisions. Logistics managers must



also understand the ABC output to determine where they have the greatest ability to influence total cost and recognize opportunities for cost or cycle time reduction.

Organizations should employ the cost, diversity, and impact rules when designing an ABC system. The cost rule suggests the organization should aggregate low cost activities into macro activities to simplify the model. Aggregation of low cost activities frequently will not distort costing especially when the aggregated activities are consumed in approximately the same proportion. The diversity rule is an approach for handling the problems of cross subsidization caused by diversity. The organization should continue to disaggregate an activity until the cost objects consume the sub-activities in proportionate amounts. The organization should consider the effects of customer as well as product diversity when disaggregating activities. The impact rule is a means for matching the level of detail in the ABC model with the cost information needed for supporting management decision-making. The project team can determine the level of detail by discussing information requirements with the future users of the system, senior management, and the internal customers receiving cost allocations from the system.

### Implementation of Activity-Based Performance Measures

The results of the study suggest a movement towards implementing activity-based performance measures within logistics. The results found only one firm actually using ABM; however, the case study and questionnaire results indicate a movement towards activity-based measurements. Over half of the case study organizations indicated plans to expand their existing ABC systems to incorporate ABM. The lack of activity-based performance measures currently in use within logistics stems from the relatively recent introduction of ABC to logistics coupled with the even more recent introduction of ABM. The implications resulting from implementing ABM within logistics include the ability to capture the measurement data, the development and acceptance of the performance measures, and the behavioral impact cost based performance measures may have on the workforce.

The ABC system must have the ability to capture or track the data used for measuring performance. The respondents indicated ABM implementation would increase the tracking requirements within their ABC systems. They anticipated costing at a higher or macro level than where they would probably measure performance. The performance measures would link the activities or performance occurring at the sub-activity level to the cost resulting at the macro activity level. As a result, logistics managers planning or implementing future ABC should pre-plan for subsequent ABM

implementation and incorporate the additional tracking capability into their ABC system.

The development and implementation of ABM will require workforce "buy-in." Logistics managers will need to determine how to sell the performance measures as beneficial to the workers and the firm. The research suggests logistics managers can begin the process by including the workers and managers affected by the change in performance measures as part of the implementation team. Another implication affecting implementation of ABM centers on communication. The logistics manager must determine how best to communicate the performance measures and how they will effect performance by the individual, effect cost and performance in other functions within the organization, and contribute to the overall competitiveness of the firm.

Activity-based performance measures will influence the behavior of the managers and the workforce. Behavior will change to conform to the performance measures. Case study organizations considering ABM indicated performance measures must be carefully developed to preclude undesirable workforce behavior. They cited examples where over emphasizing cost caused quality and customer service to decline. Undesirable behavior can be avoided by extensive communications and obtaining feedback from the workforce. Logistics managers will also need to continually monitor customer perceptions to ensure performance measurements

aimed at reducing cost or time have not overridden objectives involving customer service, product quality, or the development of competitive products and services.

#### Application to Supply Chain Management

Logistics organizations will use ABC for analyzing business processes extending through the supply chain and for evaluating alternative channel structures. The case study analysis found the majority of organizations planned to expand ABC for determining the total channel cost of moving product to market and the total cost of doing business with specific vendors, carriers, or other supply chain members.

ABC has experienced only limited use in a supply chain setting. The limited use has resulted from the very recent implementation of ABC within logistics and efforts to complete internal implementation before expanding ABC to supply chain management. The survey and case study responses indicate logistics managers plan to use ABC for better managing and controlling supply chain costs.

The application of ABC to supply chain management has several implications for logistics managers. These include the tracking of cost data across the boundaries of multiple organizations, the confidentiality of cost data, and the effect of making cost trade-offs across the supply chain. The ABC system must also possess a dynamic costing

capability allowing the logistics manager to isolate and assign costs by carrier, vendor, or distribution channel and to simulate how alternative decisions would effect total costs. The dynamic costing capability will allow logistics managers to determine the total costs of doing business with specific vendors, carriers, or other upstream or downstream channel members.

Supply chain applications of ABC will require the ability to track costs across multiple firms. The issues confronting cost tracking will include different definitions of cost categories and activities, use of multiple cost systems to obtain the data, the level of detail or aggregation required, and the location and management of the ABC system.

The confidentiality of cost information may impede implementation of ABC in a supply chain setting. ABC will provide significant visibility into the direct and indirect costs of each organization, and individual organizations may be unwilling, reluctant, or prevented from releasing their cost information to external organizations. Organizations may perceive cost sharing as another means for extracting concessions rather than a means for developing the full potential of the supply chain relationship. Supply chain applications of ABC must also address issues regarding the specific types, the amount, and frequency of cost information to be shared by the participating organizations.

The principal reason for applying ABC to supply chain management focuses on making trade-offs across all of the interlinked organizations to reduce total costs, decrease order cycle times, and achieve a competitive advantage. The trade-offs may result in reducing overall supply chain costs, but the trade-offs may also cause costs to increase for one or more organizations and to decrease costs for other organizations. Supply chain applications must develop techniques for equitably distributing the benefits and burdens resulting from the trade-off analyses.

Organizations considering the application of ABC to their supply chain should employ an incremental implementation strategy. The first stage focuses on determining the total costs of doing business with external organizations and developing performance measures. The second stage consists of exchanging ABC information with another supply chain organization. The third stage consists of sharing of activity-based information across the entire supply chain.

The first stage of ABC implementation within the supply chain focuses on more accurately determining the total costs of doing business with external organizations. Manufacturing has already used ABC to determine the total cost of vendor relationships [22:42]. The approach focuses not only the purchase price but also on more accurately assigning indirect costs to the following activities [22:43]:

- The costs of purchasing, including the costs of ordering, freight, and incoming quality control;
- The costs of holding, including the costs of storage, insurance, obsolescence and the cost of money;
- The costs of poor quality, including the costs of rejection, re-receiving, scrap, rework, repackaging, downtime, and warranties; and
- The costs of delivery failure, including the costs of expediting, premium transportation, downtime, and lost sales owing to late deliveries, and also holding and administrative costs related to early deliveries.

Logistics organizations must also adapt their ABC system to track the activities and costs affected by upstream or downstream channel members. The adaptations will enable logistics managers to assess the total logistics costs of purchasing from different vendors, shipping by specific carrier, or doing business with other supply chain members such as distributors, public or private warehouse firms, and retailers. The adaptations required for the ABC system include disaggregating activities to provide the desired level of detail, tracing costs to the activities, and developing a mechanism to track activity volumes.

The second part of the first stage includes the development and sharing of performance measures. The performance measures can be based on a comparison of nonconformance costs compared to purchase price [22:44], the volume of nonconformance activities, or other measures desired by the organization(s). These measures allow the organization to use ABC as a tool for evaluating the performance of other channel members and determining the

effect on the costs managed by other functions within the organization. The sharing of the performance measurement data focuses attention on the mutual benefits the organizations can gain from improved performance [22:44].

The second stage is the sharing of ABC information with another supply chain member. The sharing should begin by focusing on cost data pertaining to a specific process. One of the case study organizations planned to use order processing and payment as its initial supply chain application. The participating organizations would use ABC to cost the activities affected by their supply chain relationship, would exchange the costs by activity, and subsequently would identify techniques to reduce costs for both parties. Product price increases or decreases would be used as a mechanism for offsetting cost increases or decreases experienced by one of the organizations.

The second stage should initially focus on a single business process. The limited focus allows the organizations to understand the differences between their cost systems, to learn how to apply ABC across organizational boundaries, to develop techniques for burden or benefit sharing, and to foster mutual trust.

The third stage applies ABC across several organizations in the supply chain. Implementation should initially focus on a single, mutually acceptable, process affecting all of the firms. The organizations should begin



by performing an activity analysis of the process, identifying costs by activity, and identifying possible trade-offs to reduce the total process costs.

#### Implications for Cost Management Systems

The research implications for cost accounting concentrate on the accuracy of logistics costs and the changing role of logistics financial managers and cost accountants within the organization.

#### More Accurate Costing Information

The research supports earlier findings regarding the continued need for more accurate cost information within logistics. The survey and case study respondents reported their cost systems do not provide the information needed, and their firms intended to investigate or implement an ABC system. The case study results indicate many firms have implemented in-house, logistics specific ABC systems. The implications for cost accounting resulting from this finding include a loss of credibility in the cost management system and potential conflict between different reporting systems.

The development of supplemental or logistics specific cost systems suggests a loss of credibility in the firms' cost management systems. The respondents indicated the cost management system did not provide the level of detail required for making logistics decisions or provided the

wrong signals such as undercosting or overcosting specific products and services. Logistics personnel have consequently developed internal or diagnostics systems to provide the "right numbers."

The other implication focuses on the proliferation of ABC systems within a firm. The development of multiple ABC systems may produce conflicts between which organization has the more accurate numbers. The organizations may take different approaches for assigning costs and consequently obtain different numbers. The lack of a single ABC system or database managed by finance or cost accounting has the potential to eliminate many of the benefits achieved by the individual in-house systems.

Organizations can use two strategies for addressing these implications. First, the organization should determine whether a need exists for a more accurate costing system. The organization can develop an ABC system for internal management action while simultaneously using the current system for external reporting purposes. The ABC system should use the costs contained in the general ledger for determining resource and activity costs. Second, the organization should standardize the costs used by the internal ABC systems. The costs used in the functional ABC systems should flow from the general ledger accounts and should represent the amount of resources consumed by the function performing the analysis. The organization should

also establish a common definition of activities, cost drivers, and cost objects.

#### Changing Role of Cost Accountants

The research found cost accountants, and logistics financial managers, played a major role in the development of the case study implementations of ABC. The cost accountants in many cases actually performed the tasks performed in receiving, storage, warehousing, or order picking. The experience enabled the cost accountants to better understand the cost drivers for the different activities and how cross-functional relationships effect total cost. The broadened experience has two implications for the role of the cost accountant in the firm.

First, the cost accountant must develop a thorough understanding of the activities within each of the major processes. The respondents indicated the cost accountant or logistics financial manager, had to become a process expert. The understanding became necessary for developing meaningful cost drivers and for identifying non-value-added activities and elimination or reduction techniques.

Second, the expertise enabled the cost accountant, or logistics financial manager, to perform new roles in the firm. The respondents indicated their firms more actively used cost accountants in continuous improvement or TQM programs because of their process knowledge and financial

expertise. The cost accountants provided considerable insight into how process changes or potential cost trade-offs would impact costs throughout the organization.

#### Section V — Suggestions for Future Research

This research has only begun to explore the potential contribution of activity-based costing to logistics management. ABC implementations within logistics have occurred only within the last few years, and further study can identify additional means of obtaining more accurate costing information and for improving logistics decision-making and performance measurement. The following suggestions for future study would validate and extend the results obtained in the research.

##### Longitudinal Study

Future research should perform a longitudinal study of several organizations implementing ABC within logistics. The study would examine the organizations as they passed through the five ABC implementation stages. The results would validate the steps occurring in each stage of the implementation methodology, identify key decisions and trade-offs, and determine how the decisions made during implementation affected the capability of the ABC system to support logistics decisions, cost trade-offs, performance measurement, and accurately cost logistics activities.

The longitudinal study should employ a case study approach for examining the implementation process. A case study approach would allow the researcher to observe firsthand the impediments confronting the organization, issues considered during each stage, and the rationale used to support specific ABC design considerations. The approach would also permit the research to identify differences and commonalities between the case study organizations and to recommend alternative approaches. The in-depth analysis would also enable the researcher to assess how the decisions made during the planning and design stages affected ABC performance during the operational stage.

A longitudinal case study does have some limitations future research should consider. The case study approach, due to the limited number of firms, will preclude generalization of the results to all logistics organizations. The researcher may also experience difficulty in identifying several organizations about to implement ABC and willing to share their results. The organizations may have different definitions of ABC and implement systems varying in complexity and sophistication. The organizations may also have different purposes for implementing ABC systems, and the researcher may be unable to draw conclusions regarding how the design of these systems impacted performance measurement or logistics decision-making.

### Survey of Logistics Applications

A future study should perform a broad based survey of ABC applications of logistics. The study would confirm whether organizations have continued to implement ABC within logistics, and whether the apparent movement towards implementing ABM and applying ABC to supply chain management has occurred. The research would also address how the surveyed organizations have used ABC to obtain a competitive advantage in the marketplace.

The research should use a survey or questionnaire for data collection. The survey would allow the researcher to obtain inputs from a large number of logistics professionals to determine the current state of ABC implementation. The survey instrument should address topics concerning why the respondent's organization implemented ABC, applications within logistics, how the organization has used the ABC data in logistics decision-making, whether the use of ABC has identified opportunities for a competitive advantage and how the organization has used the information to become more competitive, and how the organization intends to use the information in the near and long term.

A survey of logistics organizations implementing ABC may encounter several drawbacks. The small number of ABC applications within logistics may preclude drawing any statistically significant conclusions. The organizations may perceive ABC as a competitive advantage and may be

unwilling to release any information. ABC may take many forms, and the responding organizations may not consider their systems to be a form of ABC. A survey of strictly logistics professionals may not address the right target audience in each organization. The proponents advocating the adoption of an ABC system in logistics may be in other functions within the organization such as finance or senior management. Finance or cost accounting also may have ownership for the ABC system, and logistics managers may receive the output without recognizing the information as activity-based.

#### Supply Chain Analysis

A future investigation should examine how to implement ABC within a supply chain environment. The research would identify the activities used, techniques used for costing the activities, the effect ABC had on the supply chain relationships, the performance measures used, the types of cost data shared, the methods used for distributing benefits and costs, and any impediments encountered and how they were overcome. The research would provide greater insight into how to reengineer business processes across a supply chain and the effect cost-based performance measures would have on supply chain relationships.

The investigation should adopt a case study approach for examining a supply chain application. The researcher will need to carefully restrict the scope of the research. Examination of more than one case study may prove difficult due to the limited number of existing supply chain applications and the need to study several organizations within each supply chain. The case study approach provides the advantages of obtaining in-depth feedback from each organization regarding the implementation process, how ABC has affected their operations and relationships with other organizations, differences in costing techniques, and the advantages and disadvantages resulting from implementation.

A case study analysis of a limited number of supply chain applications will experience many of the same limitations of the longitudinal study. The small number of case studies will preclude the researcher from generalizing the results across all logistics organizations and supply chain relationships. Differences in supply chain structure will also preclude generalization. The research will have no foundation for determining why some supply chain ABC applications may succeed while others may fail. The researcher will also have received exposure to a limited number of techniques and inter-organizational relationships. The research will not have sufficient depth for identifying "best practice" or benchmarking the results against other supply chain relationships.



### Summary

Chapter Five presented the conclusions of the research. The conclusions addressed the findings obtained from examining the research propositions and other findings made during the research effort. Observations made during the research resulted in several prescriptive conclusions for implementing ABC within logistics. The research has several implications relating to logistics management and cost accounting. Suggestions for future study identified topics for validating and extending the research results. The following appendices contain the survey instruments and results obtained during the research, the interview protocol, and a profile of the organizations participating as case studies in the research.

Activity-based costing will play an important role in managing logistics costs throughout the 1990s. The application of ABC to logistics will effect logistics decision-making, performance measurement, and supply chain management. The research has presented how eleven leading-edge firms have implemented and applied ABC to the management of their logistics systems.

APPENDIX A  
ACTIVITY-BASED COSTING (ABC)  
QUESTIONNAIRE

**The Ohio State University  
Activity-Based Costing (ABC)  
Confidential Questionnaire**

WE ARE INTERESTED IN BOTH THOSE WHO HAVE OR HAVE NOT DECIDED TO IMPLEMENT AN ACTIVITY-BASED COST SYSTEM. IF YOUR FIRM IS NOT USING ABC, PLEASE COMPLETE QUESTIONS 1-5 AND SKIP TO QUESTION 14.

**PLEASE ASSUME A CORPORATE-WIDE, RATHER THAN A DEPARTMENTAL, PERSPECTIVE WHEN ANSWERING THE FOLLOWING QUESTIONS:**

**1. What is the current status of ABC in your organization?**

(Check one)

- |   |   |
|---|---|
| <input type="checkbox"/> Has not been considered                | <input type="checkbox"/> Considered, decided against      |
| <input type="checkbox"/> Internal planning stage                | <input type="checkbox"/> Programming/development          |
| <input type="checkbox"/> Development completed, not implemented | <input type="checkbox"/> Canceled prior to implementation |
| <input type="checkbox"/> Implementing                           | <input type="checkbox"/> Complete and in use              |
| <input type="checkbox"/> Project on hold                        |   |
| <input type="checkbox"/> Other (please specify)_____            |   |

**2. Where did the proposal to implement ABC originate (Department)?\_\_\_\_\_**

**3. Who spearheaded ABC implementation (Title)?\_\_\_\_\_**

**4. Why did your firm examine an ABC system?**

(Check all that apply)

- |  |  |
|--|--|
| <input type="checkbox"/> Potential cost savings                    | <input type="checkbox"/> Performance measurement         |
| <input type="checkbox"/> Replace current cost accounting system    | <input type="checkbox"/> Behavior modification           |
| <input type="checkbox"/> Improve operating efficiency              | <input type="checkbox"/> Pricing of products or services |
| <input type="checkbox"/> Current cost accounting system inadequate |  |
| <input type="checkbox"/> Other (please specify)_____               |  |

**5. If you have decided against ABC, was it because:**

(Check all that apply)

- |   |  |
|---|--|
| <input type="checkbox"/> Inappropriate to your business | <input type="checkbox"/> System not cost justified   |
| <input type="checkbox"/> Too complicated                | <input type="checkbox"/> Other (please specify)_____ |

6. What management level approved continuation of ABC beyond initial exploration? \_\_\_\_\_

7. Was ABC approved based on cost savings/avoidance? \_\_\_\_ Yes \_\_\_\_ No

8. Where would you currently place your firm regarding ABC implementation?  
(Check one)

____ Problem definition stage	____ Operational stage
____ Planning stage	____ Implementation stage
____ Development stage	

9. What functions in your firm have implemented an ABC system?

(Check all that apply)

\_\_\_\_ Manufacturing, production, operations  
\_\_\_\_ Marketing  
\_\_\_\_ Logistics: warehousing, transportation, purchasing, order processing  
\_\_\_\_ Other (please specify): \_\_\_\_\_

10. Do you intend to implement ABC in other areas within your entire firm?

\_\_\_\_ Yes \_\_\_\_ No If no, why? \_\_\_\_\_

11. What benefits has your firm obtained from ABC?

(Check all that apply)

\_\_\_\_ Improved cost information  
\_\_\_\_ Cost control  
\_\_\_\_ Improved performance measurements  
\_\_\_\_ Better product pricing  
\_\_\_\_ Eliminate unnecessary or redundant work  
\_\_\_\_ Greater insight into types of work performed and cost drivers  
\_\_\_\_ Other (please specify): \_\_\_\_\_

12. Has your firm included ABC information in budgeting or strategic planning?

\_\_\_\_ Yes \_\_\_\_ No

13. What problems did your firm encounter while implementing ABC? \_\_\_\_\_

14. How would you classify your business?

Manufacturing \_\_\_\_ Wholesaling \_\_\_\_ Retailing \_\_\_\_

15. Do you have any interest in participating in our ABC research project?

\_\_\_\_ Yes \_\_\_\_ No

**If interested in participating and obtaining additional information regarding our research results, please identify your point of contact below.**

Whom may we contact regarding ABC implementation at your firm?

Name: \_\_\_\_\_

Telephone: \_\_\_\_\_

**Thank you for your help. Please mail the questionnaire in the enclosed envelope.**

APPENDIX B  
BACKGROUND QUESTIONS FOR  
RESEARCH CRITERIA ANALYSIS

INTERVIEW GUIDE — INITIAL CONTACT  
BACKGROUND AND CRITERIA ANALYSIS

1. Name: \_\_\_\_\_
2. Company: \_\_\_\_\_
3. Division: \_\_\_\_\_
4. Has your firm initiated management discussion or action to begin an activity-based costing system within your logistics functions?
5. What is the current status of ABC implementation?
6. Did your organization plan to replace a previous cost system with ABC or to use ABC to supplement existing financial information?
7. Would you categorize the type of commodity or service produced by your organization as industrial or consumer?
8. Has your organization implemented ABC in any other functions? If yes, please provide the department or function and indicate if ABC implementation preceded or followed implementation in the other function(s).
9. Has your organization implemented activity-based management? If yes, please indicate the departments or functions. If no, have you used ABC information to revise departmental performance measures?

10. Would you and your firm be willing to participate as a test subject for research examining ABC implementation and its impact on logistics decision-making? The research would require a total of three to five hours of personal interviews with individuals from logistics, finance, and the ABC implementation team.

11. Which individuals would you recommend for personal interviews? (Name, organization, telephone number) Should I contact these individuals directly?

12. Please identify any other firms, with contact points and telephone numbers, you believe have implemented an ABC system.

13. May I use your name as a reference if I contact these firms?

14. May I contact you for additional information, if needed?



APPENDIX C  
INTERVIEW PROTOCOL

INTERVIEW PROTOCOL  
PART I BACKGROUND INFORMATION

Organization: \_\_\_\_\_ Date: \_\_\_\_\_

Industry: \_\_\_\_\_

Persons Contacted:

\_\_\_\_\_  
\_\_\_\_\_

1. What were the annual dollar sales of your business unit in the most recent fiscal year?

_____ Under \$50 million	_____ \$301 to 500 million
_____ \$50 to \$100 million	_____ \$501 to \$1 billion
_____ \$101 to \$200 million	_____ \$1 to \$2 billion
_____ \$201 to \$300 million	_____ Over \$2 billion

2. How many total line items or SKUs does your business unit handle, inbound and outbound?

No. of SKUs	Inbound	Outbound
0 to 1,000		
1,001 to 2,000		
2,001 to 3,000		
3,001 to 5,000		
5,001 to 10,000		
10,001 or more		

3. Please indicate the size of your logistics system:

Elements	Number of:
Suppliers	
Plants	
Distribution Centers	
Warehouses	
Customer destinations	

4. Organization of Logistics:

a. How has your firm organized its logistics functions?

- ☐ As part of each corporate division  
☐ As a centralized (staff) logistics department  
☐ As a combination of some divisional and centralized activities  
☐ As a separate logistics division

b. What functions has the firm placed under logistics?

5. Please indicate the proportion of direct costs to indirect or overhead costs:

- ☐ Percentage of direct costs  
☐ Percentage of indirect (overhead) costs

6. Please use the following scale indicate the amount of diversity in how different products, customers, or supply channels consume logistics overhead:

	Consume Same Amount			Consume very differently	
	1	2	3	4	5
Products					
Customers					
Supply Channels					

PART II  
ABC IMPLEMENTATION PROCESS

PROBLEM DEFINITION

1. Why did your firm initially consider developing an ABC system? Did you encounter, or expect to encounter, any problems requiring more accurate cost information? What benefits did you expect to obtain?
2. Where did the proposal to implement ABC originate?
3. Did your organization previously implement an ABC system in another department or division? Did previous experience affect the decision to implement ABC in logistics?
4. Did you benchmark any other organizations' implementation processes or ABC systems before deciding to proceed with your system?
5. Please discuss the role of outside vendors or consultants played in your decision to implement an ABC system. Did they play a continuing role during system design and implementation?
6. How did your organization justify the decision to proceed with ABC implementation? Was approval based on dollar savings or another metric?
7. Please identify the three most significant impediments your organization had to overcome to obtain approval for proceeding with ABC implementation. How did you overcome these impediments?

## PLANNING

8. Please identify the objectives your firm planned to achieve by implementing an ABC system. Did the objectives center on cost reduction or performance measurement? Did the objectives change during implementation? Did you have any specific objectives for logistics?

9. What role did your firm expect the ABC system to perform: A replacement for the existing cost accounting system? A system to supplement existing cost accounting information? A one-time analysis of costs? Did your analysis change the intended role for ABC?

10. How many functions or departments did you plan to include in your ABC system? Did you add or delete any later? How many individuals from each of the functions or departments participated on the project team?

11. Who "championed" your ABC effort? Did this same person lead the project team?

12. How much time, money, and manpower did you plan to allocate to your ABC project? Did you encounter any significant changes during implementation?

## DATA COLLECTION

13. Please describe the process(es) and information sources used for identifying resources, resource drivers, activities, activity drivers, and cost objects. What sources provided the most information? the least information?

14. How accessible was the cost and activity data? What problems did you encounter? How did you obtain information that was not readily accessible?

#### ABC SYSTEM DESIGN

15. Did your firm perform an activity analysis? What did your firm learn from the activity analysis?

16. Please identify the resources used in your ABC system. How many did you decide to use? What techniques did you use to trace the consumption of resources by activities?

17. Please identify the activities used in your ABC system. How many activities does your system include? How did you measure the number of times an activity is performed?

18. Please describe the different types activity or cost drivers used in your system.

19. Please describe the different types of cost objects used in your system.

20. Please identify any overhead costs which your system did not directly trace to a cost object. Why did the project team decide not to trace these costs? Please provide an estimate of overhead directly assigned using ABC versus volume based allocation (i.e., 80/20 split, 50/50 split, etc.).

## IMPLEMENTATION

21. How long have you considered your ABC system operational?
22. What types of employee training did your organization perform, who performed the training, and who attended?
23. Has your ABC system required any modifications? What factors drove the need to modify the system? Who maintains the system?
24. How frequently do you update the cost information in your ABC system? How is the system updated? How frequently would prefer to update the cost data?
25. If you were implement an ABC system all over again, knowing what you know now, what would you do differently?

PART III  
ABC COST INFORMATION

LOGISTICS COST INFORMATION

1. Please discuss the impact of ABC on the reporting of logistics costs in your income statement or other financial documents. Please indicate whether ABC has affected cost reporting and gross income.

2. Do the costs and profitability reported by your ABC system closely track with the information provided by your organization's financial reporting system? Does your organization attempt to reconcile the differences?

3. Please describe the reports or information provided by your ABC system? Who, and at what levels, receives the information? What are the highest and lowest levels?

4. Has ABC affected the identification of costs incurred by (check all that apply):

- ☐ Organization or division
- ☐ Product line
- ☐ Natural expense
- ☐ Function
- ☐ Sub-function
- ☐ Other, please explain:

4a. Does your ABC system enable you to determine costs and profitability by product, customer, supplier or supply chain?

5. Did the ABC system capture all of the important logistics costs and non-financial information needed by your organization? If not, what information did it not capture?



6. Please describe how your ABC system determines capacity utilization. Does your system report underutilization or variances by cost center or function? Please discuss how you determined capacity, the amount of capacity consumed per activity, and variance reporting. Does your system assign underutilized capacity to the cost object?

7. Please discuss how ABC has impacted the budgeting of logistics costs.

8. Please identify any planned uses of ABC cost information and reports within your organization.

PART IV  
LOGISTICS DECISION-MAKING AND  
PERFORMANCE MEASUREMENT

PERFORMANCE MEASUREMENT

1. Has your firm implemented activity-based management (ABM)? Have you applied ABM within logistics? If yes, please identify the measures used for evaluating logistics performance.

2. Has the implementation of ABC or ABM changed how your firm evaluates logistics performance? If yes, please identify the areas where performance measures have changed and whether cost plays a major factor.

3. Do you use ABC to trace cost the cost savings achieved through quality or continuous improvement to a specific cost object? Does ABC play a major role in justifying proposed changes? Please identify an example.

4. Does your organization use ABC information to evaluate the managerial or supervisory performance? If yes, please discuss how you use the information.

5. Please discuss the amount of detail required within your ABC system to measure performance. Does your cost analysis require the same amount of information?

6. Have you used your ABC system to drive continuous improvement within your organization? Please describe your approach.

## LOGISTICS DECISION-MAKING

7. Please discuss how ABC has affected your ability to control logistics costs. Has ABC increased the visibility of logistic costs? Can you use ABC information to show a cause and effect relationship between cost objects, activities, and resource categories?

8. Has ABC increased the visibility of logistics costs to upper management? Has the control of logistics costs become more important since ABC implementation?

9. How has ABC impacted the logistics organization? Have you eliminated any activities or diverted resources? Did you change the physical layout, workload assignments, paperwork flow, or cost reporting?

10. Where do you believe ABC has specifically changed your decision-making process?

11. How frequently do you receive outputs from the ABC system? What information do you receive? How do you use the information?

## INTERNAL RELATIONSHIPS

12. Have you used ABC to demonstrate how other organizations impact logistics costs or vice versa? If yes, please describe your analysis.

13. Have the cost reported by ABC altered any of the cost trade-offs occurring with logistics or between logistics and other departments; for example, did ABC impact the trade-off between warehousing costs and production run length?

14. Has the amount of coordination and communication increased between logistics and other departments since ABC implementation?

15. Has ABC altered the perception of logistics costs within your department? Within other departments? Has it altered the organizational structure? Please identify examples.

16. Have you encountered any problems with using ABC data when discussing costs with other departments in your organization?

#### SUPPLY CHAIN RELATIONSHIPS

17. Have you used ABC as part of your decision-making process to establish an alliance or long-term relationship with another supply chain member? If yes, what information did you require and what role did it play in your decision? If no, do you have plans to use ABC information?

18. Do ABC or ABM play a role in the evaluation of your strategic alliances? If yes, please explain how you use ABC or ABM to evaluate performance. If not, do you intend to use activity-based performance measures?

19. Do you periodically meet with your suppliers, customers, or other channel members to discuss logistics costs or processes? Have any of the meetings resulted in the reduction of costs or improved efficiencies? How have you attempted to equitably share benefits and allocate costs?

20. Have you shared any of your ABC information with you channel partners to improve service or reduce costs? If yes, please discuss the process selected and the results.

21. What problems have you encountered when applying ABC information with organizations outside your firm? How would you recommend resolving the problem?

22. Has the implementation of ABC increased the amount of communication or coordination occurring within the supply chain?

## ATTITUDES

For the following statements, please indicate SA for strongly agree, A for agree, NO for no opinion, D for disagree, or SD for strongly disagree.

Overall, ABC has had a positive impact on the firm.	SA	A	NO	D	SD
I am comfortable using ABC.	SA	A	NO	D	SD
I would recommend ABC to other logistics firms or organizations.	SA	A	NO	D	SD
The advantages of ABC outweigh the disadvantages of ABC.	SA	A	NO	D	SD
I believe ABC provides greater insight into logistics costs.	SA	A	NO	D	SD
I believe ABC places too much emphasis on managing costs as opposed to customer service.	SA	A	NO	D	SD
ABC represents another technique to manipulate accounting data and not manage the logistics organization.	SA	A	NO	D	SD
ABC information provides too much detail for management decisions.	SA	A	NO	D	SD
ABC will have little impact on what I do.	SA	A	NO	D	SD
ABC information will enable me to improve my operations.	SA	A	NO	D	SD
ABC use will reduce logistics costs.	SA	A	NO	D	SD
ABC implementation will improve logistics efficiency.	SA	A	NO	D	SD
ABM provides a more useful tool for evaluating my performance.	SA	A	NO	D	SD
ABM provides more accurate information for evaluating my subordinates	SA	A	NO	D	SD
ABC information is useful for determining the costs of using specific suppliers.	SA	A	NO	D	SD

ABC information is useful for analyzing supply chain costs.	SA	A	NO	D	SD
I hope ABC is not implemented.	SA	A	NO	D	SD
ABC requires too much detail.	SA	A	NO	D	SD
ABC will increase communications between organizations within my firm.	SA	A	NO	D	SD
ABC will increase communications with other firms in my supply chain.	SA	A	NO	D	SD
I expect ABC use to become the norm for managing logistics costs.	SA	A	NO	D	SD

APPENDIX D  
SURVEY RESULTS  
ABC APPLICATIONS WITHIN LOGISTICS



## SURVEY RESULTS

### ABC APPLICATIONS WITHIN LOGISTICS

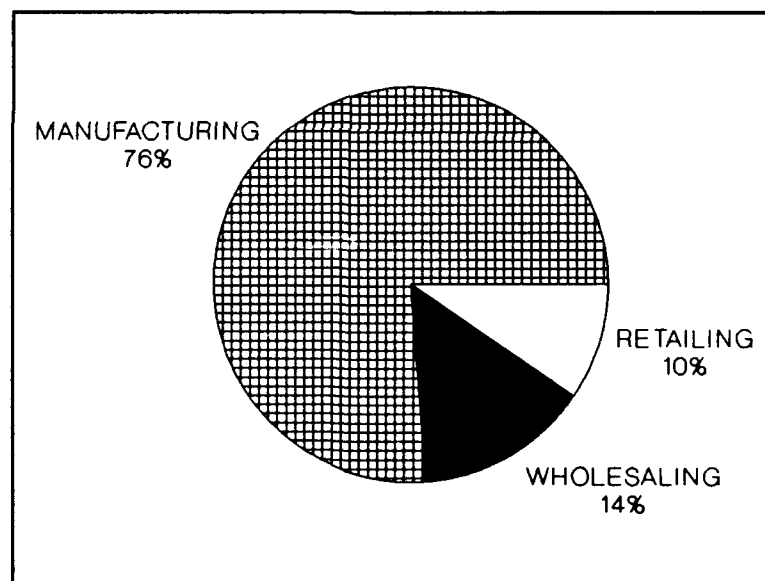
#### Introduction

The survey had the principal objectives of determining whether any leading logistics organizations had implemented an ABC system and exploring whether sufficient interest existed in ABC to merit continued research. The firms included in the survey represented the leading edge of business practice and the most likely firms to have begun the stage IV integration breakthrough identified by A.T. Kearney [1:274-275]. As a result, the firms sampled may not necessarily represent the typical or average logistics firm. However, the selection of these firms may provide a better indicator of the future direction of logistics practice than by obtaining a larger or more representative database of current practice. The survey had the additional objectives of determining whether the leading logistics organizations had an ongoing ABC system, obtaining information regarding the implementation process, and identifying potential future directions of ABC applications.

### Survey Results

The survey included one hundred large companies possessing a vice-president of logistics or distribution. The survey targeted these firms as having the greatest potential need for obtaining accurate logistics costs and for reengineering their logistics processes.

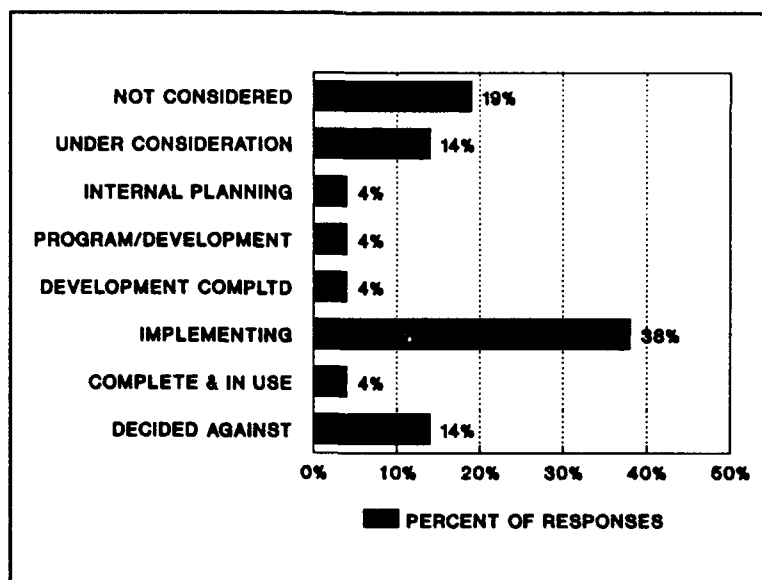
The responses yielded twenty-two usable questionnaires. Companies responding to the questionnaire received follow-up telephone contacts to clarify individual responses. Figure One provides a breakout by type of respondent.



**Figure 7. Types of Businesses Participating in the Questionnaire**

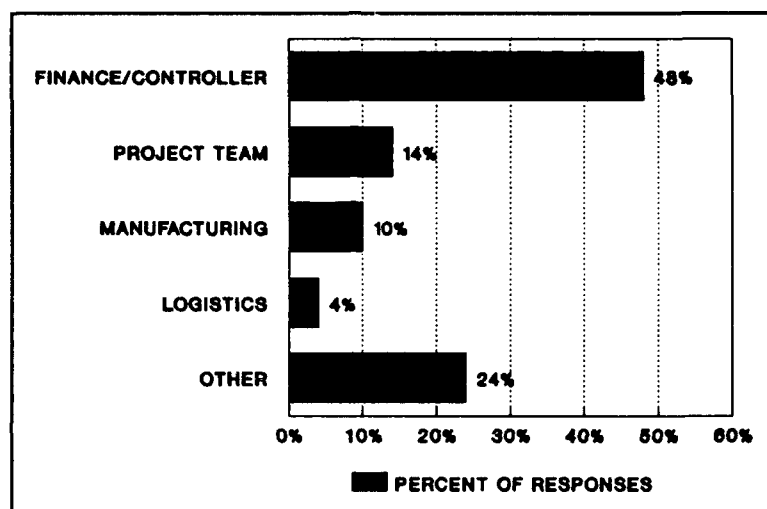
The majority of firms responding to the survey had implemented some form of an ABC analysis. Follow-on contacts revealed most ABC implementations consisted of a

one-time "snapshot" analysis of logistics costs. The firms planned to perform subsequent ABC analyses on a periodic basis to measure performance, update cost data, or diagnose potential problems. A very small percentage of the responding firms planned to replace their existing cost management system with ABC. Fourteen percent of the respondents had examined ABC and did not consider it a viable alternative. "More practical alternatives" represented the most frequently cited reason for deciding against ABC. Other factors cited included "higher priorities, too complicated, not cost justified, and unsure of how to proceed."



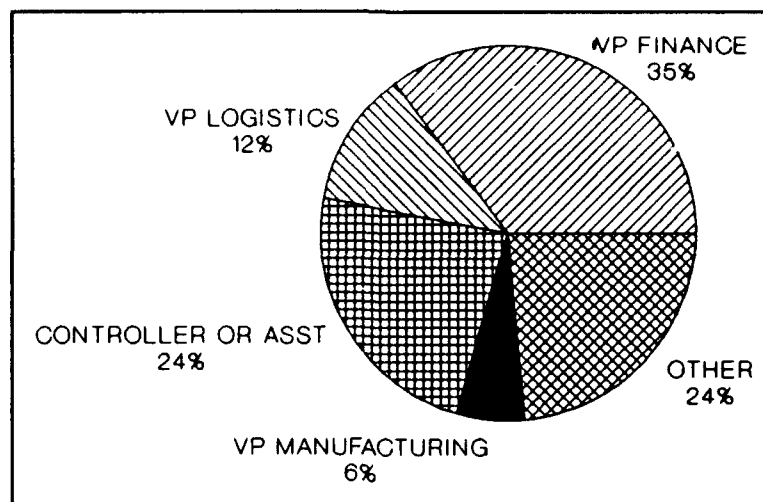
**Figure 8.** The Current Status of ABC Within the Surveyed Firms

Most of the firms identified two of the major advantages of ABC as the reasons for examining ABC implementation: accurate product pricing and performance measurement. Other responses focused on actions unique to the responding firm and did not reveal any trends.



**Figure 9.** Origin of ABC Proposal

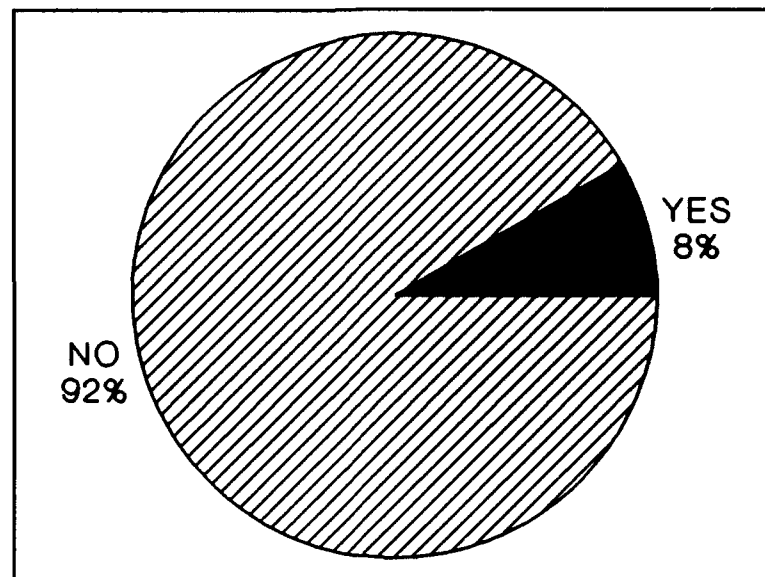
The controller or the vice president of finance played a central role in originating the ABC proposal and spearheading implementation. The ABC expertise in most of the responding firms resided in the finance or accounting department. The responses to the questionnaire frequently came from the controller or vice-president finance. The targeted respondent, the vice president of logistics or distribution, frequently forwarded the questionnaire to the finance department for response.



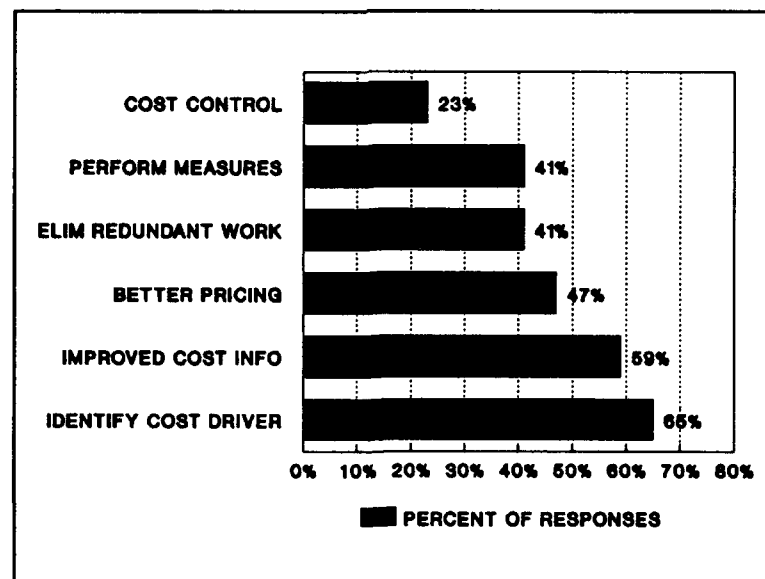
**Figure 10.** Individual Spearheading ABC Implementation Effort.

Senior management played a major role in determining whether to proceed with ABC implementation. Firms implementing ABC to revise product costing or to develop a performance measurement system required senior management approval. Project team generally approved ABC applications used for analysis purposes.

Cost savings or avoidance played virtually no role in the decision to implement an ABC system. The firms generally perceived the benefits of ABC as exceeding the implementation costs.



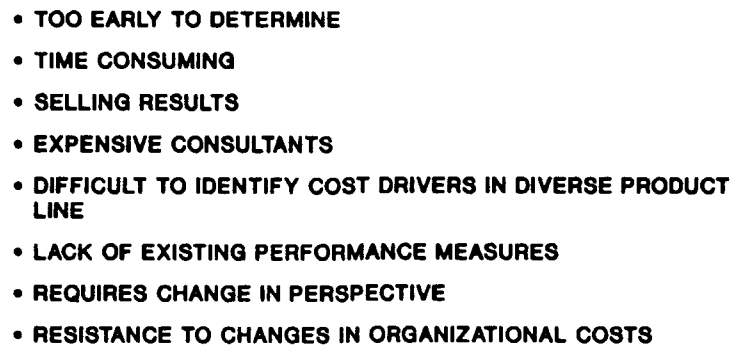
**Figure 11.** Responses to Whether ABC Was Justified on Cost Savings or Avoidance



**Figure 12.** Benefits Obtained From ABC Implementation

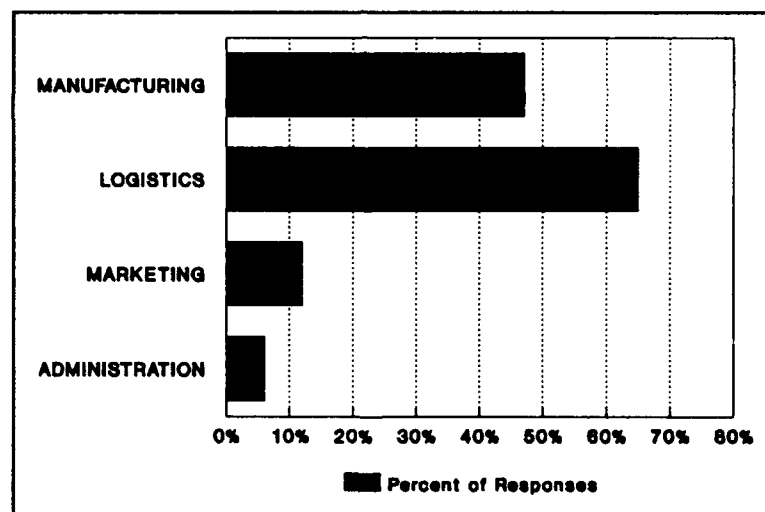
The benefits of implementing an ABC system closely matched the reasons for implementing an ABC system. The follow-up contacts received favorable comments regarding the information produced by the ABC system. Most firms initially focused on the cost data and planned to explore the possibility of implementing an activity-based management (ABM) system.

The respondents encountered a wide variety of problems during implementation. No pattern appeared in the results. Figure 13 summarizes the problems cited by the respondents having implemented an ABC system.

- 
- TOO EARLY TO DETERMINE
  - TIME CONSUMING
  - SELLING RESULTS
  - EXPENSIVE CONSULTANTS
  - DIFFICULT TO IDENTIFY COST DRIVERS IN DIVERSE PRODUCT LINE
  - LACK OF EXISTING PERFORMANCE MEASURES
  - REQUIRES CHANGE IN PERSPECTIVE
  - RESISTANCE TO CHANGES IN ORGANIZATIONAL COSTS

**Figure 13.** Problems Encountered During ABC Implementation

The survey requested the respondents to identify the functions having implemented an ABC system. Logistics and manufacturing produced the largest responses. The large logistics response may have resulted from the questionnaire's focus on companies with a senior logistics position. Subsequent contact with the firms indicated logistics implementations generally had a narrow focus. The firms had targeted areas where overhead had grown or represented a significant portion of their total costs. Areas targeted included purchasing, order processing, and administration.



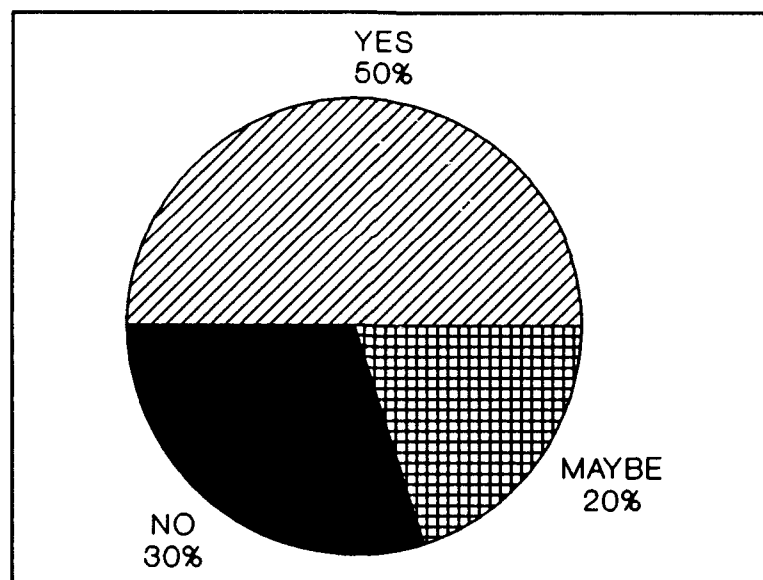
**Figure 14.** Functions Implementing ABC

The majority of respondents indicated the use of ABC information in their budgeting and strategic planning processes. The ABC data acted as a baseline for projecting changes in activity costs. Applications within strategic



planning focused primarily on identifying areas for process reengineering or for strategic positioning.

The firms expressed general satisfaction with their ABC implementation, and half have plans to extend their ABC implementation to other areas in the firm. Projected implementations frequently mentioned plans to expand ABC to encompass a larger range of logistics activities. Several firms also indicated a desire to incorporate sales.



**Figure 15.** Percentage of Respondents Planning to Implement ABC Elsewhere Within Their Firm

Follow-on contacts suggested a trend toward more variable pricing. The firms must offer a diverse range of services to remain competitive; however, they want their charges to accurately reflect and recover the cost of the

services performed. The other trend most frequently cited included implementation of ABM. The respondents plan to use ABM as a foundation for continuous improvement.

### Conclusions Drawn from the Survey

Leading logistics organizations have begun to implement ABC to more accurately cost activities and measure performance. The responding firms indicated a need for more accurate pricing and performance measures and have achieved these benefits as a result of incorporating an ABC methodology. Implementation has not typically occurred on a system-wide basis with ABC replacing the previous cost management system. The sophistication and extent of ABC implementation has taken many forms based on the particular problems confronted and the information desired by the firm.

The survey results indicated ABC may take many forms. ABC systems span a continuum from the traditional cost model with a single cost driver to a very elaborate cost system with activities for every conceivable type of work with corresponding activity drivers. Many firms appear to have implemented some form of an ABC system. The firms reported using multiple cost drivers to capture the costs of performing specific activities, providing a unique service, or serving a particular customer. However, they generally did not equate the use of multiple cost drivers or the tracing of costs with an ABC system.

The level of ABC sophistication varied by the proportion of overhead costs and the amount of diversity experienced within the firm. Cost accuracy improved with the sophistication of the model as did the implementation cost. Firms appeared willing to increase the level of sophistication as long as the perceived benefits exceeded the costs of obtaining the additional accuracy. The firms have found that a moderate level of sophistication will generally address the problems of product, customer, or channel diversity, and more complex models produced only marginal improvements in cost accuracy. The proportion of indirect to direct costs and the diversity of products or services can also signal the level of sophistication required. Companies with low proportions of indirect costs indicated fewer benefits or changes in cost assignments. Larger proportions of indirect costs and greater diversity in products or services may signal the need for a more sophisticated model.

The respondents perceived ABM as a natural outgrowth from ABC. Most firms indicated a future intent to implement ABM to reengineer and take costs out of their logistics processes. ABC and ABM implementation may simultaneously occur depending on the level of sophistication and the on-going capability to track performance measures.

ABC has provided the leading logistics firms with a more accurate system for costing activities and measuring

performance. ABC may take many forms, from a relatively simple model to a very elaborate model. The level of ABC sophistication employed appears to be based on the objectives of the firms, on-going capability to track activity information, the proportion of indirect costs, and the diversity of products, services, customers, or supply channels.

APPENDIX E  
EXTRACTS FROM THE  
1993 WAREHOUSING EDUCATION AND RESEARCH COUNCIL  
AND THE OHIO STATE UNIVERISITY  
SURVEY OF WAREHOUSING AND DISTRIBUTION COSTS

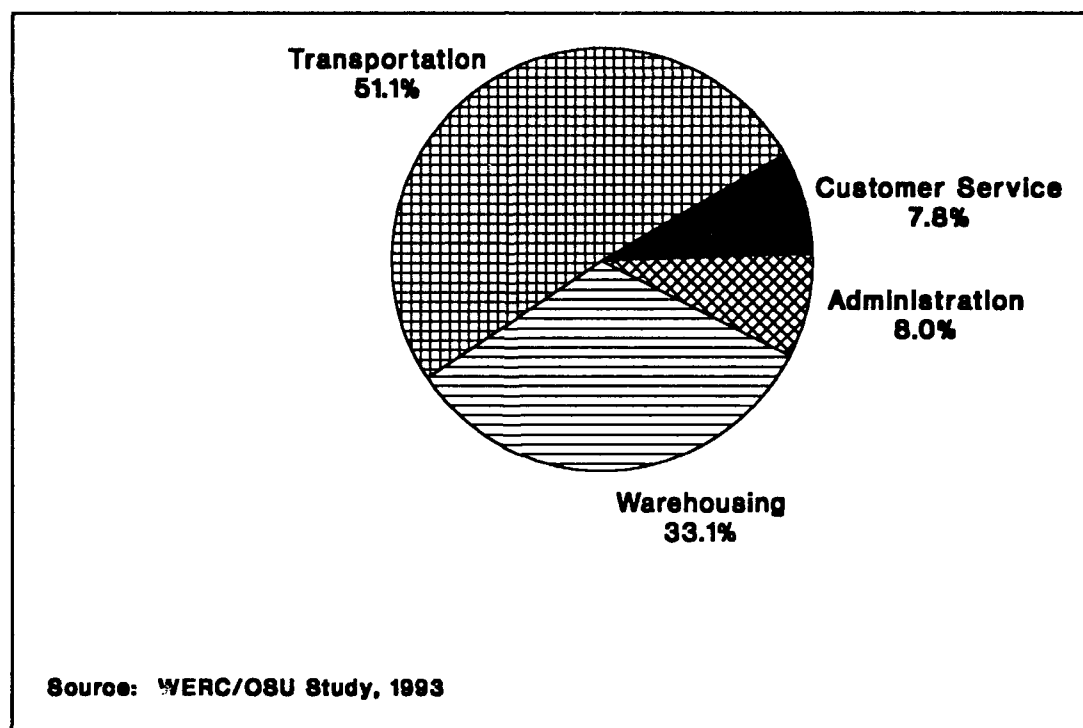
EXTRACTS FROM  
THE 1993 WAREHOUSING EDUCATION AND RESEARCH COUNCIL (WERC)  
AND THE OHIO STATE UNIVERSITY  
SURVEY OF WAREHOUSING AND DISTRIBUTION COSTS

The following extracts from the 1993 WERC/OSU survey were reproduced with permission of the Warehousing Education and Research Council.

The Logistics Research Group at The Ohio State University, in conjunction with the Warehousing Education and Research Council (WERC), surveyed the members of WERC, the Council of Logistics Management (CLM), and various other warehousing professionals during March 1993. The survey had the purpose of learning more about present warehousing and distribution costs and industry's future expectations.

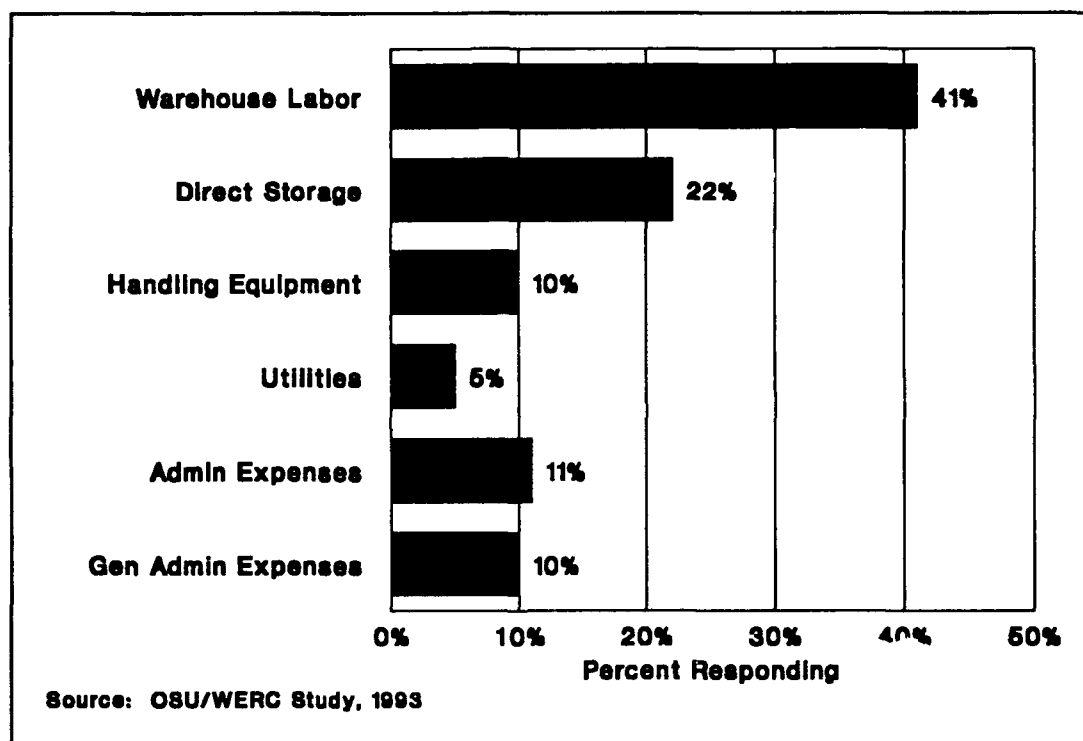
The results were drawn from a detailed, eight page questionnaire. Six hundred and eighty surveys were sent, and by the cut-off date, fifty-nine responses were received. Two Hundred and fifty-nine individuals from the original list with facsimile numbers received a shortened two page questionnaire by facsimile. The shortened version produced an additional seventeen responses. The net response rate, including both versions of the questionnaire, was approximately eleven percent.

The survey requested anonymous responses to encourage the submission of potentially sensitive information. The anonymous responses preclude knowing the exact identity of the sample population, and sample may not truly represent the total population of warehousing executives. However, the size and quality of the original mailing indicated the sample results may be reasonably considered to be representative of the population of warehousing professionals.



**Figure 16.** Selected Categories as a Percentage of Total Logistics Costs

The respondents indicated transportation accounted for 51 percent of their total logistics costs and represented the the largest proportion of their costs. Warehousing consumed the second largest amount of cost and accounted for 33.1 percent of the responding companies' total costs.



**Figure 17.** Company Warehousing Cost by Major Category (1992)

The respondents broke down their company's current warehousing costs into the major categories of warehouse labor, handling equipment, direct storage (includes rent, depreciation, maintenance, and security), utilities, administrative expenses (includes clerical and supervisory



salaries and data processing), and general administrative expenses (not directly related to any one facility).

Warehouse labor accounted for the largest percentage of warehousing cost. Utilities accounted for the lowest percentage. The results reflect the breakdown of warehousing costs within these categories will not significantly change by 1995.

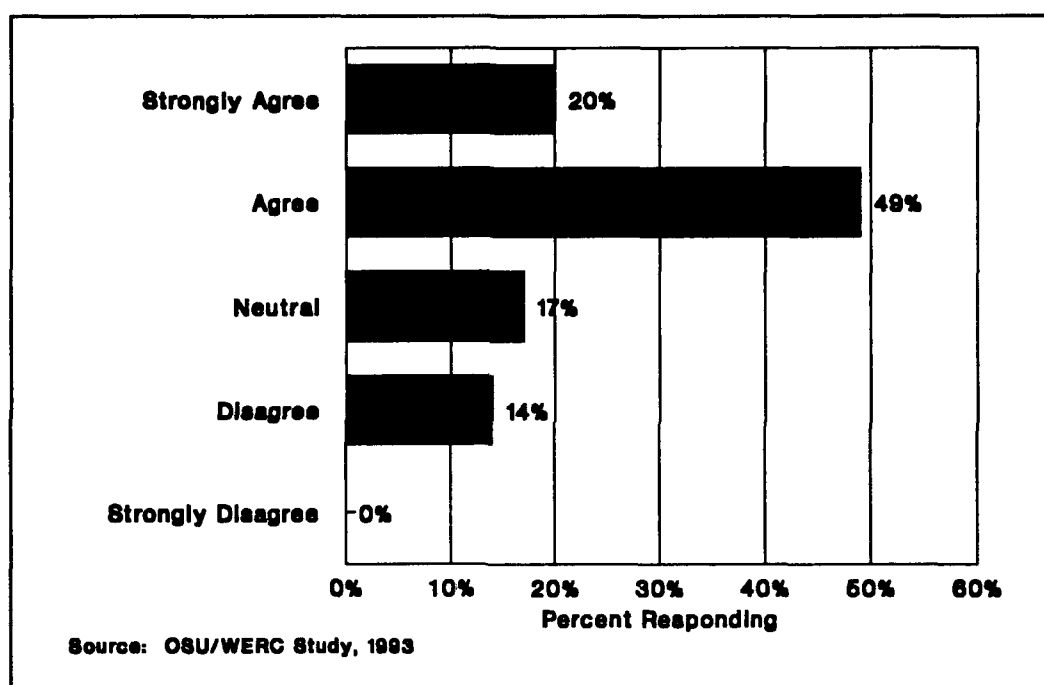
TABLE 17  
BREAKDOWN OF WAREHOUSE COSTS  
1992 - 1995

Cost Category	1992	1993
Warehouse Labor	41.2%	39.5%
Direct Storage	22.3%	23.2%
Handling Equipment	10.3%	10.3%
Utilities	5.2%	5.3%
Administrative	11.2%	11.6%
General Administrative	9.8%	10.2%

The WERC/OSU survey asked several questions to detect the executives' future plans in warehousing. Four of the questions addressed their current requirements and plans for warehousing costing. The questions used a five point scale ranging from strongly agree to strongly disagree.

Figure 18 reflects the executives' responses to the question:

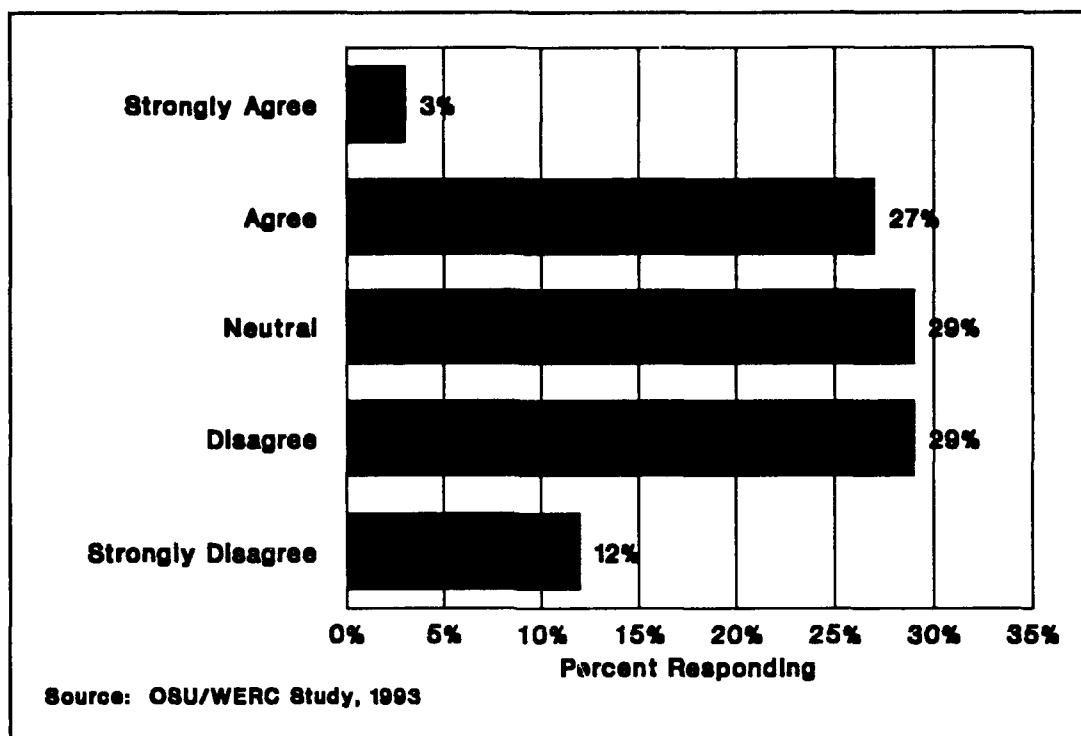
In the future, my company will require the capability to accurately break out direct and indirect warehousing costs by type of product, customer, service or warehousing activity to remain cost competitive.



**Figure 18.** Requirement to Break Out Overhead Costs by Product, Customer, Service, or Warehousing Activity

The second question attempted to determine whether the warehousing executives perceived or had obtained a competitive advantage through more accurate costing.

My firm has obtained a competitive pricing advantage by accurately tracing the indirect costs of general administration, material handling, warehousing MIS, and utilities to individual warehousing services.



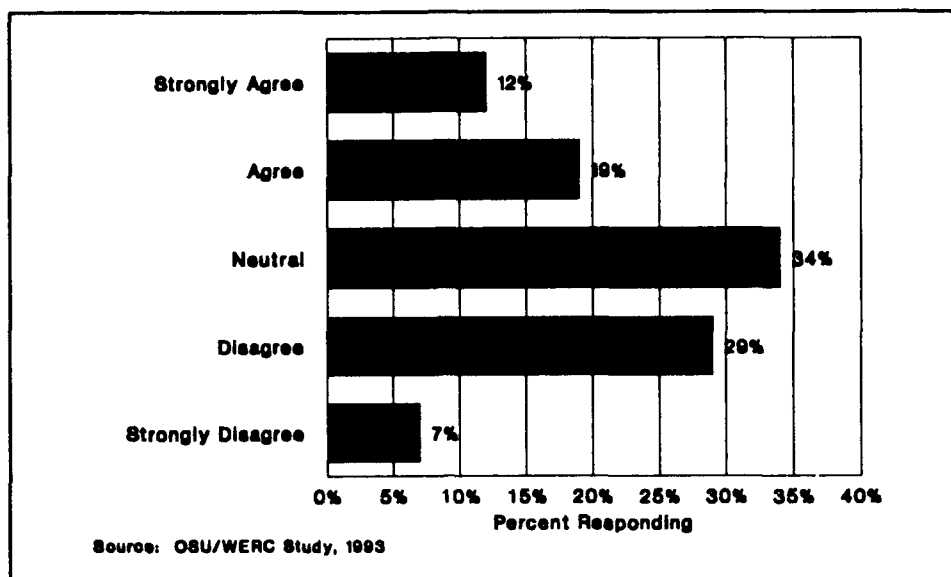
**Figure 19.** Responses Regarding Requirement to Trace Indirect Costs to Specific Activities

The third question in the series requested the warehousing executives to indicate whether their firm had investigated the use of Activity-Based Costing:

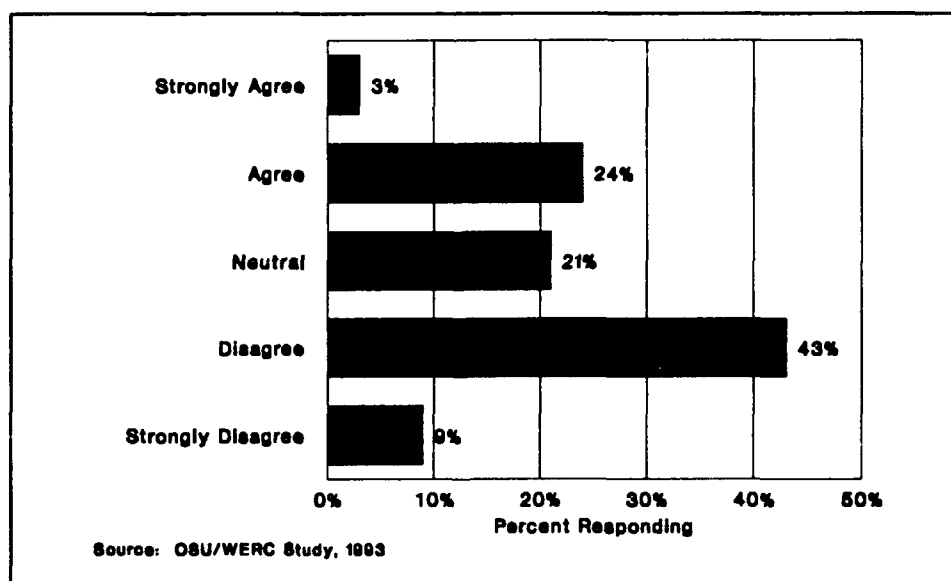
My firm is investigating the use of Activity-Based Costing.

The final question asked the executives to indicate whether competitive pricing had forced their firm to more accurately break out overhead costs.

Competitive pricing has forced my firm to revise our warehousing charges by breaking out warehousing overhead by type of service, product or customer.



**Figure 20.** Percentage of Firms Investigating ABC.

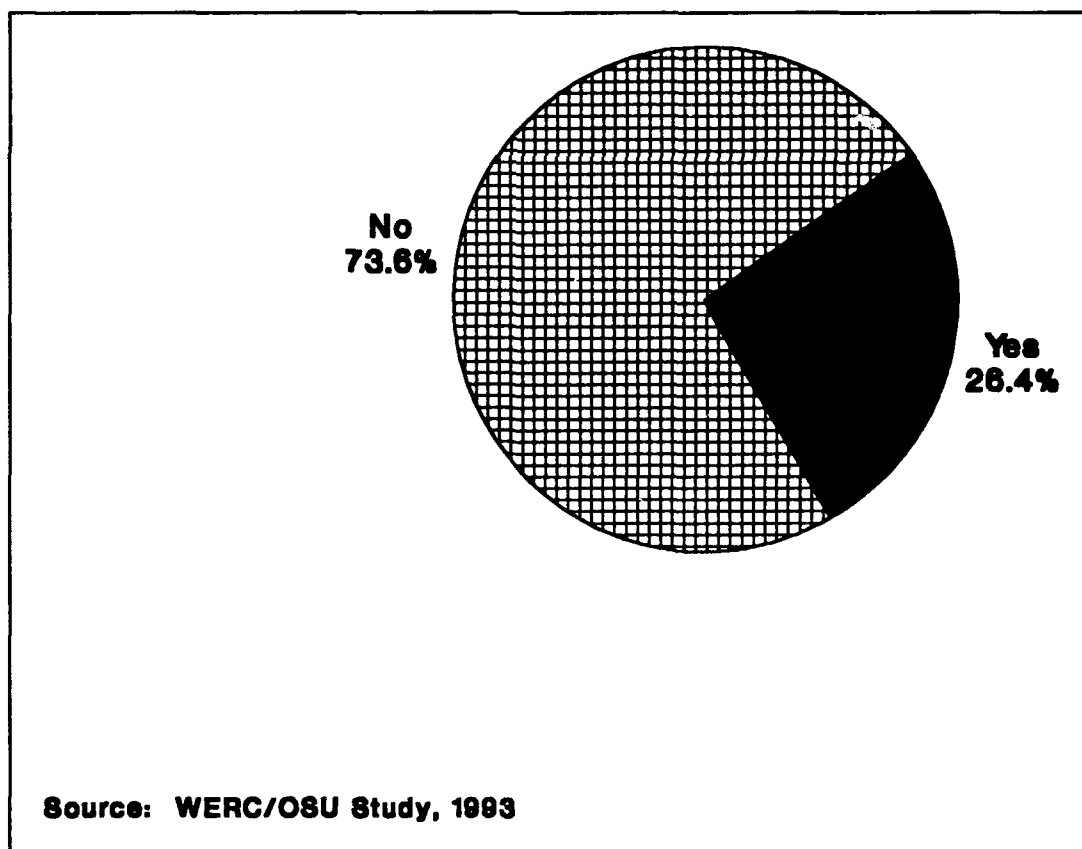


**Figure 21.** Impact of Competitive Pricing on Overhead Breakout by Service, Product or Customer

The WERC/OSU survey included a section on "Warehousing Costing and Cost Allocation." The questions requested a yes or no response with the opportunity to provide written comments. The following figures summarize the responses provided by the warehousing executives.

**Question:**

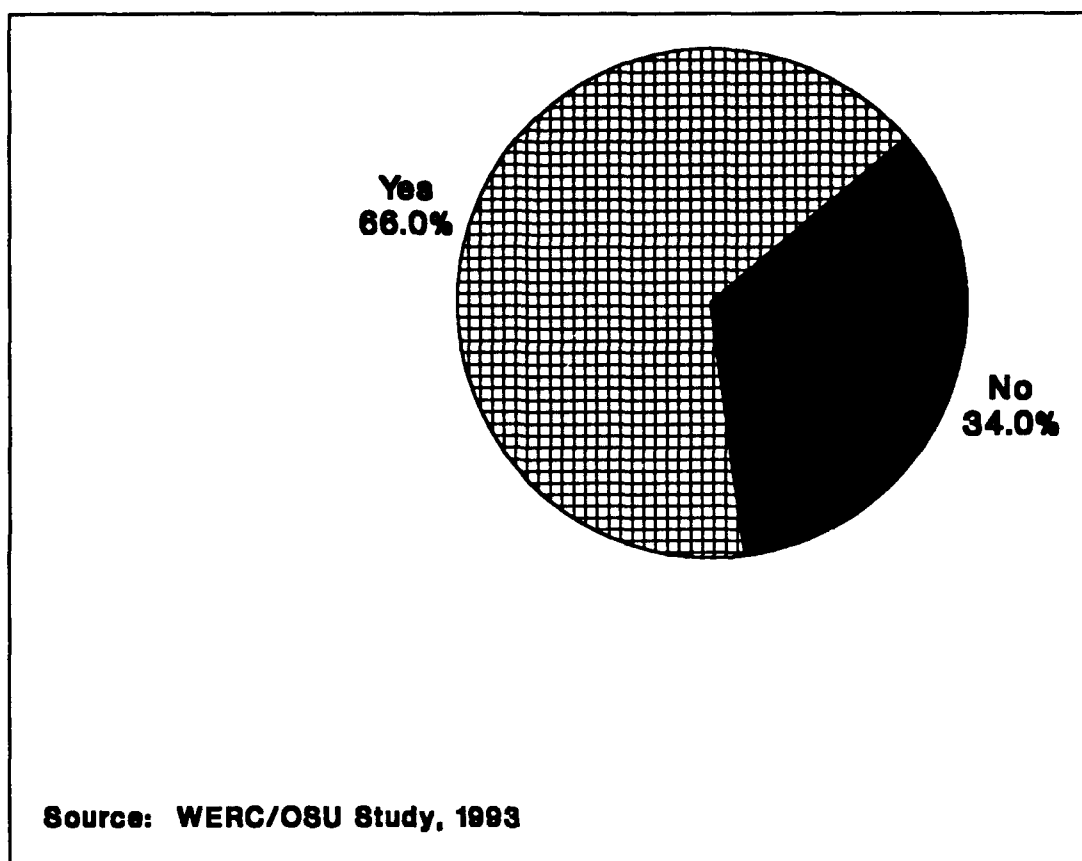
My firm uses a single factor such as direct labor or square footage to determine warehousing charges.



**Figure 22.** Use of a Single Factor to Determine Warehousing Charges.

**Question:**

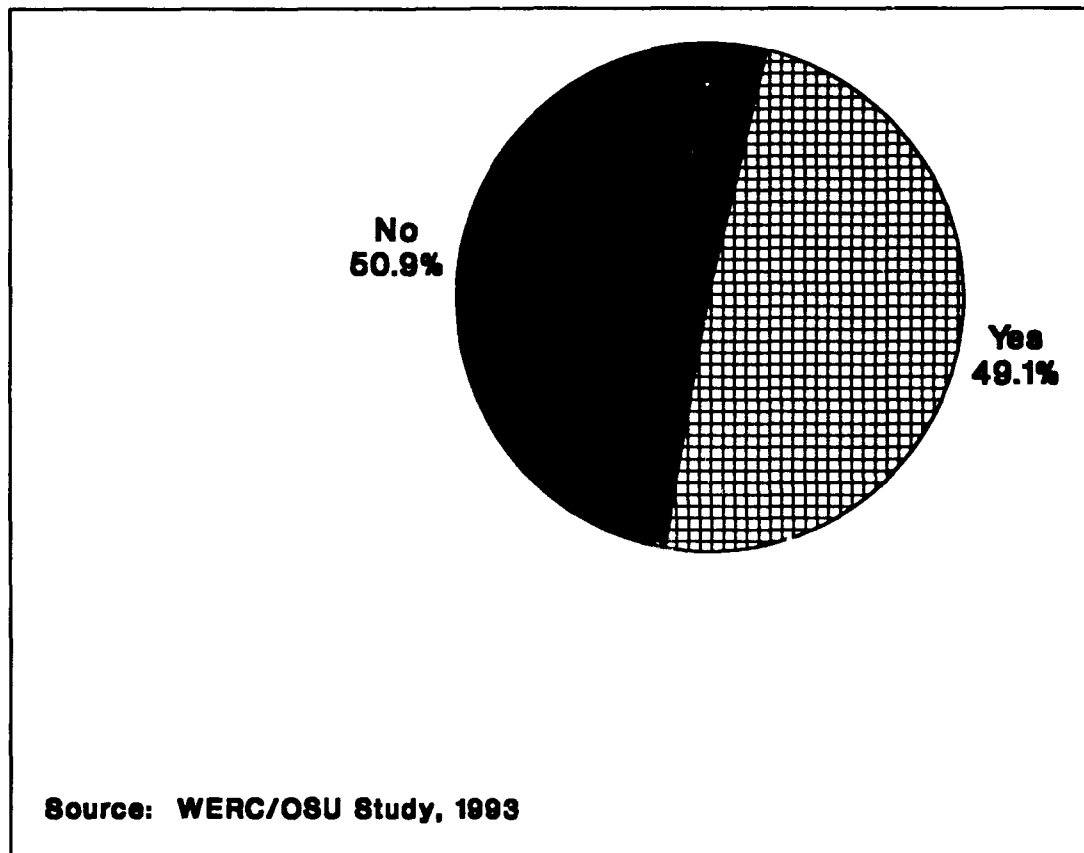
My company considers other factors such as the type of product or services provided to determine warehousing charges.



**Figure 23.** Use of Multiple Factors to Determine Warehousing Charges.

**Question:**

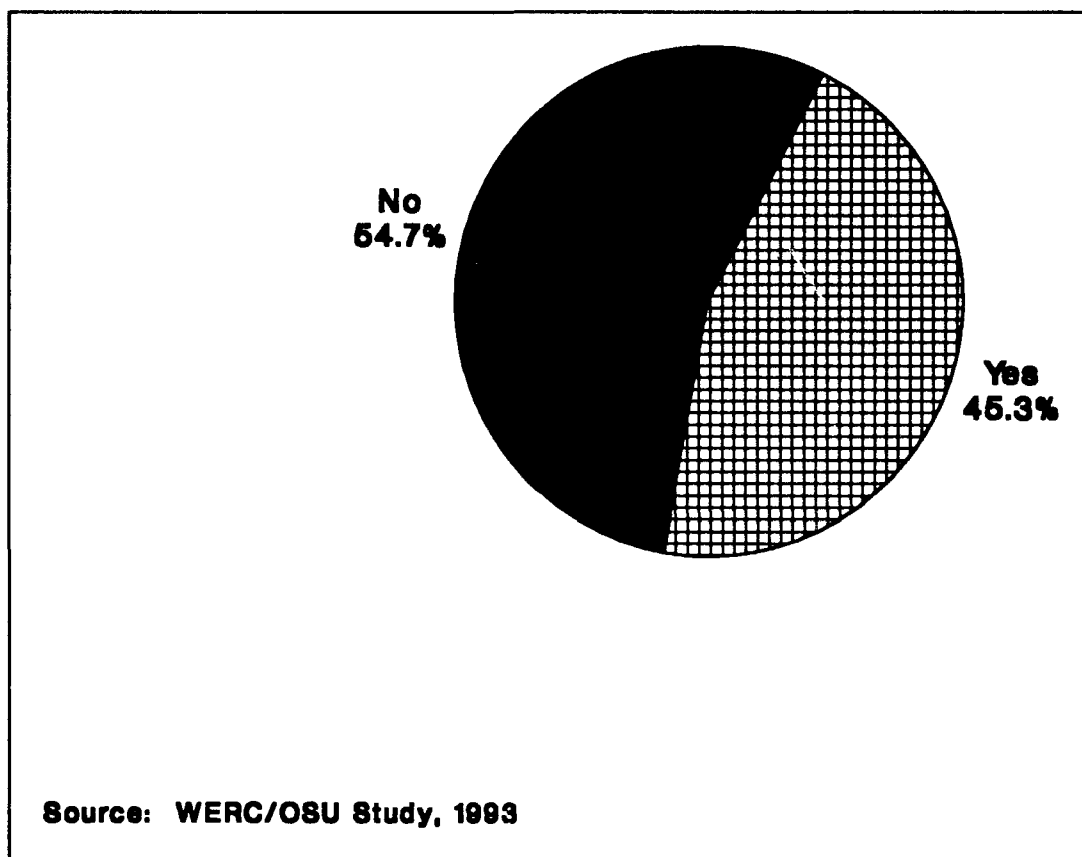
Our company breaks out warehousing overhead by major activity such as receiving, storage, packaging, order picking, or shipping.



**Figure 24.** Ability to Breakout Warehousing Overhead by Major Activity

**Question:**

My company can accurately determine the amount of general administration, supplies, warehousing MIS, and utilities consumed by each major warehousing activity.

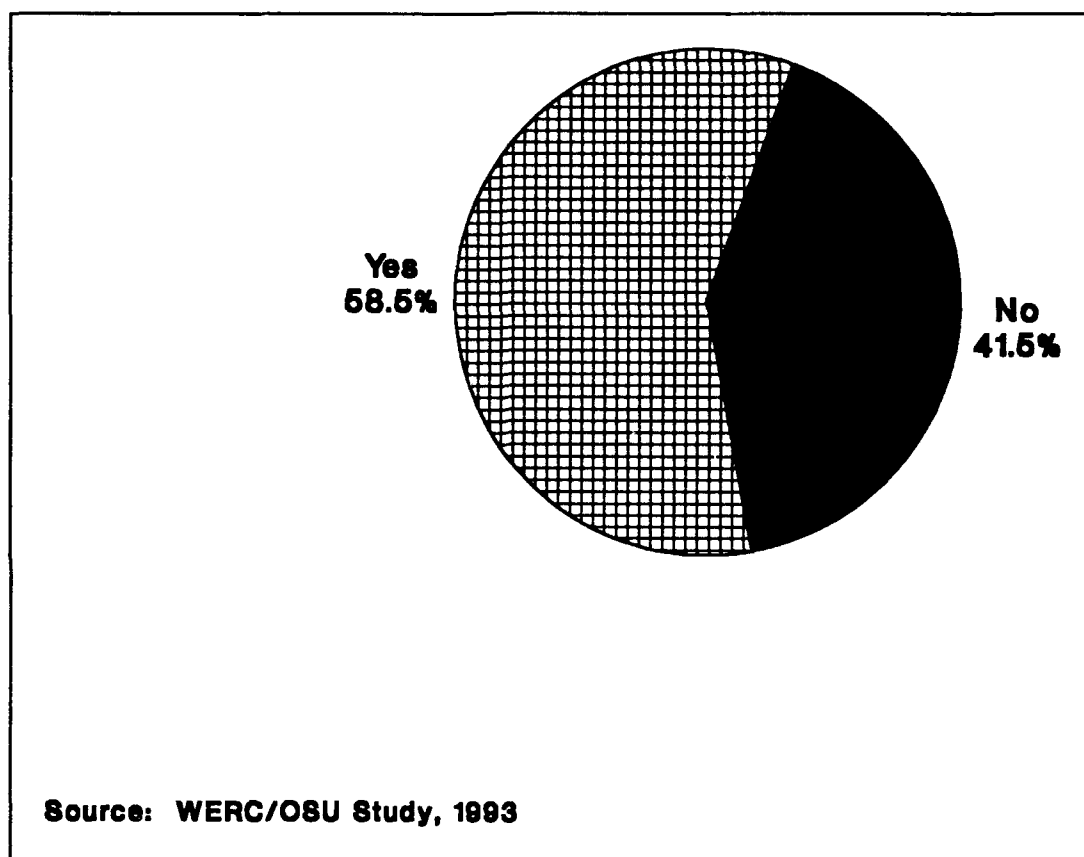


**Figure 25.** Warehousing Executives' Ability To Trace Resource Costs to Specific Activities



**Question:**

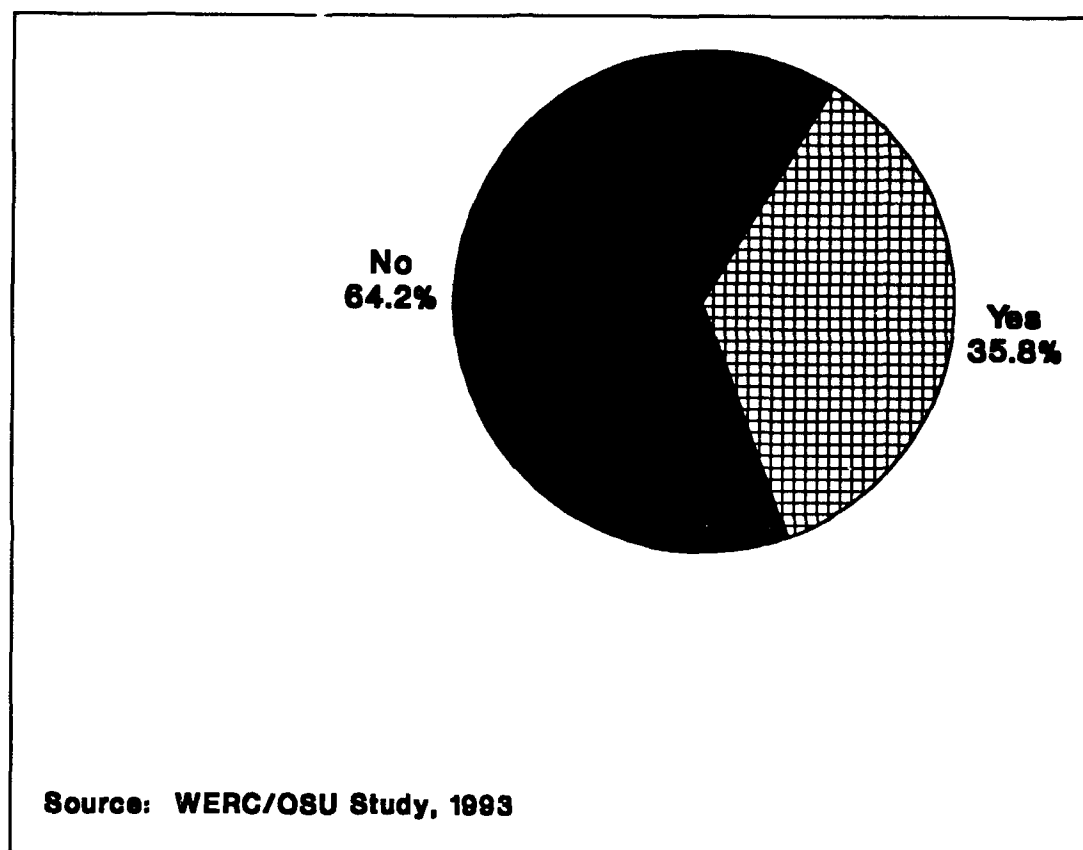
Our company can readily calculate the costs of loss and damage, returned goods, re-warehousing or preparation of bills of lading.



**Figure 26.** Ability to Calculate Costs of Specific Activities

**Question:**

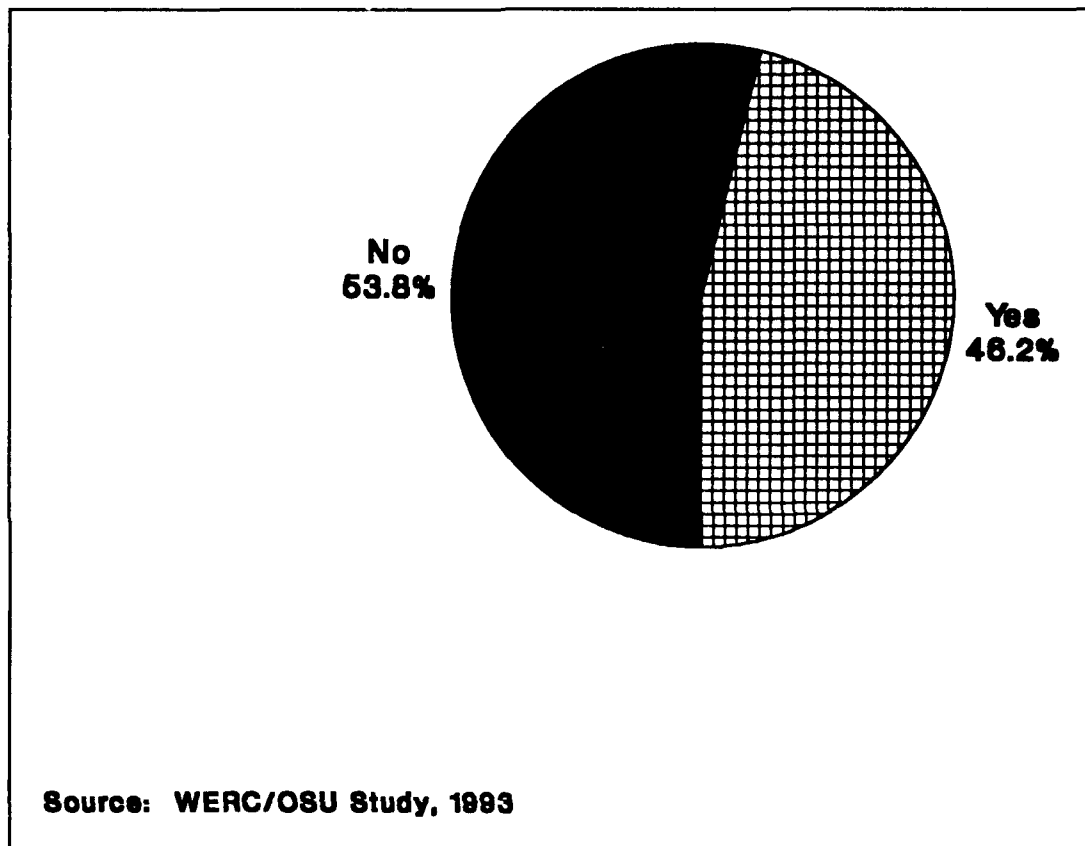
My company breaks out the costs of loss and damage, returned goods, re-warehousing or preparing bills of lading by product, customer, or mode of shipment.



**Figure 27.** Ability of Warehouse Executives to Break Out Activity Costs by Product, Customer, or Mode.

**Question:**

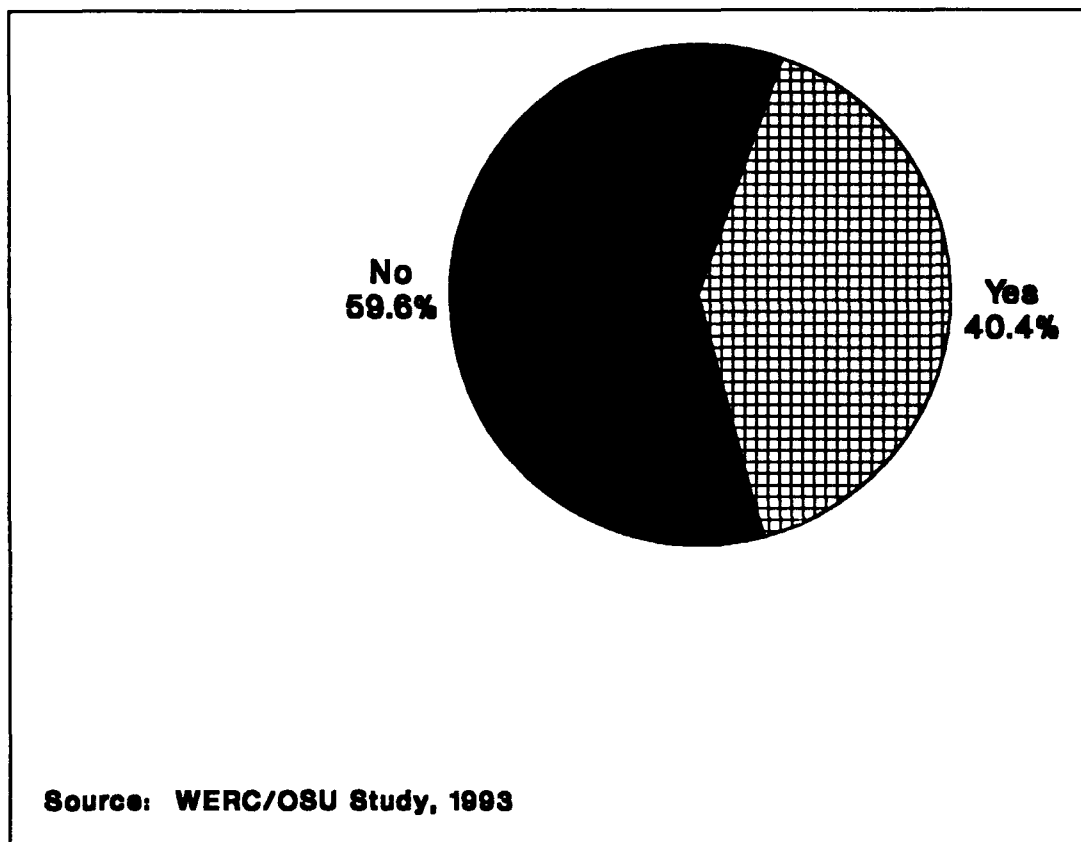
Our performance measurement system tracks workload volume and the amount of general administration, warehousing MIS, supplies, etc. actually used by each responsibility work center.



**Figure 28.** Ability of Performance Measurement System to Track Resources and Activity Volumes

**Question:**

My company has integrated our performance measurement, cost management, budgeting and financial reporting systems within the last five years.



**Figure 29.** Integration of Performance and Financial Management Systems

Appendix F  
Logistics Costing Questionnaire

## LOGISTICS COSTING CONFIDENTIAL QUESTIONNAIRE

1. Please indicate the proportion of direct and overhead costs in your firm:

Direct logistics labor and material costs:	%
Logistics overhead costs:	%
Total logistics costs:	100%

The following section asks three hypothetical questions. Please indicate your opinions by providing short, concise, handwritten responses. If you require additional space, please attach another sheet of paper:

2. Your chief competitor has gained a competitive advantage by significantly reducing the overhead or indirect costs required for moving their product to market. What cost information would you require to identify cost reduction opportunities within your firm's logistics overhead?

Do you currently possess the capability to obtain this information? Please identify any information you cannot obtain.

If not available, what changes could your firm make to obtain the information?

3. Another firm within your supply chain has invited your firm to participate in a quick response relationship. What information would you ideally like to have for analyzing the cost implications to your firm's logistics system?

Do you currently have this information available? Please indicate any missing information.

If not available, what would your firm need to do to obtain the information?

4. Your firm has decided to implement a continuous improvement program. What information will you require to implement a continuous improvement process and measure performance in logistics? What cost information would you require to justify changes in your logistics processes?

Do you currently possess the capability to obtain this information?

What changes would you recommend to your firm's senior executives to obtain any required information?

Listed below are some statements regarding Logistics Costing and Cost Allocation.  
Please circle the response which most closely corresponds with your opinion:

(SA) Strongly Agree, (A) Agree, (NO) No Opinion, (D) Disagree, (SD) Strongly Disagree

1. Our firm allocates logistics overhead or indirect costs to products, services, or customers on a percentage basis of a single cost driver such as direct labor or product volume.	SA A NO D SD
2. My company includes other factors such as the type of product or service provided to determine logistics costs.	SA A NO D SD
3. My company offers a diverse range of products and logistics services to our customers.	SA A NO D SD
4. The products and logistical services produced by our firm consume unequal amounts of logistics support such as packaging, labor, transportation, and information requirements.	SA A NO D SD
5. Our company breaks out logistics overhead costs based on <i>actual consumption</i> to major processes such as customer service, warehousing, transportation, and physical distribution.	SA A NO D SD
6. My firm can further break out logistics overhead costs to the activity or task level such as order processing, receiving, storage, order picking, shipping, and transporting.	SA A NO D SD
7. My company can accurately determine the amount of general administration, supplies, MIS, and utilities actually consumed by individual logistics activities or tasks.	SA A NO D SD
8. Competitive pricing has forced my firm to revise our logistic charges according to how individual services, products, customers, or distribution channels consume logistics resources.	SA A NO D SD
9. I can use the output from my company's cost accounting system to clearly demonstrate a cause and effect relationship between the work performed and the amount of overhead consumed.	SA A NO D SD
10. Our company can calculate the costs of loss and damage, returned goods, re-warehousing, or preparing bills of lading by product, customer, or mode of shipment.	SA A NO D SD
11. My firm has obtained a competitive advantage by pricing logistics services according their actual consumption of material handling, MIS, utilities, and other overhead costs.	SA A NO D SD
12. Our performance measurement system can directly translate productivity improvements at the activity or task level into cost savings within our logistics system.	SA A NO D SD
13. My firm is investigating the use of Activity-Based Costing (ABC) as a method for more closely defining logistics costs.	SA A NO D SD

14. My firm has implemented, or is in the process of implementing, an ABC system.	SA A NO D SD
15. Our firm does not consider the allocation or assignment of overhead or indirect costs as an important element of logistics costing or performance measurement.	SA A NO D SD
16. My firm intends to evaluate potential vendors based on the total cost of doing business rather than focusing solely on price.	SA A NO D SD
17. Our current cost accounting system possesses the capability to trace and accumulate the total logistics costs of dealing with specific suppliers.	SA A NO D SD
18. In the future, my company will require the capability to accurately break out direct and indirect logistics costs by type of product, customer, service or logistics activity to remain cost competitive.	SA A NO D SD

**Thank you for participating in our survey of logistics costs. If you want to obtain the results of our survey, please attach your business card to the questionnaire and place in the enclosed, postage paid envelope. All individual responses will remain confidential.**



APPENDIX G  
LOGISTICS COSTING QUESTIONNAIRE RESULTS

### LOGISTICS COSTING QUESTIONNAIRE RESULTS

The logistics costing questionnaire was performed a survey to determine the sophistication of the cost management systems currently used by major logistics firms. The mailing included 245 corporations possessing a vice-president of logistics or distribution position. A cover letter accompanied the survey requesting participation in the study and indicating participants would receive a copy of the survey results. The questionnaire produced only 13 responses with only 11 considered usable.

The questionnaire consisted of two parts. The first part requested a breakout of logistics costs, direct versus indirect, and asked several hypothetical questions regarding the types of cost information required to support logistics decision-making. The second part consisted of 18 questions focusing on the complexity and capabilities of the respondent's cost management system. The following paragraphs contain the questionnaire results.

Part I.

1. Please indicate the proportion of direct and overhead costs in your firm:

Number of responses, 11; response averages follow:

Direct logistics labor and material costs: 63.3%

Logistics overhead costs: 36.7%

2. Your chief competitor has gained a competitive advantage by significantly reducing the overhead or indirect costs required for moving their product to market. What cost information would you require to identify cost reduction opportunities within your firm's logistics overhead?

"Activity-Based Costing"

"Transportation, Direct Labor, and Facility"

"Direct Labor Costs and Transportation Costs"

"A breakdown into controllable versus noncontrollable, then a further breakdown into variable and fixed (for both controllable and noncontrollable)."

"Activity costs across supply chain"

"Cost of improvements in administration, systems and equipment and space utilization--resulting savings in labor and operating expenses."

"Define cost by function and calculate cost per transaction."

"One would need to know detail on those elements which make up overhead and indirect costs and the impact on operations if they were reduced."

"Activity and Volume Related Costs"

"Freight, Warehousing, and Allocated Overhead by Trade Channel"

2a. Do you currently possess the capability to obtain this information? Please identify any information you cannot obtain.

"Yes" (5 responses with no further comments)

"Drop size for cash customers"

"We cannot readily obtain these breaks, especially a break on salaries and wages (e.g. warehouse labor would be controllable and variable and the D.C. manager and staff would be controllable and fixed in the short run)."

"Some elements are available via snap shot annual surveys and/or cost center reporting."

"Yes, via Activity Based Costing Studies"

"With the exception of freight it is difficult to identify the logistics overhead required of a class of customers."

2b. If not available, what changes could your firm make to obtain the information?

"Implement Hand-Helds for all salesmen"

"We need a new and more flexible payroll system. We need ability to segregate operations inside a D.C. (e.g. OTR drivers from general W/H labor)."

"Major effort to identify costs would be required."

"The accounting system should be activity-based and flexible. Costs that can't be directly linked to an activity should be recorded separately and not allocated."

3. Another firm within your supply chain has invited your firm to participate in a quick response relationship. What information would you ideally like to have for analyzing the cost implications to your firm's logistics system?

"Current cost per cubic meter or cost per case versus proposed cost per cubic meter or cost per case; service impact, ie currently 1/week delivery versus ?."

"Inventory Carrying Cost, Inventory Levels, EDI Development, Variable Costs, and Systems Cost."

"Wage rate of direct labor, mode used in supply chain to distribute finished product."

"Incremented labor and materials for that specific customer."

"Activity costs for processes impacted."

"Extra labor costs based on the shipping requirements; administrative and system requirements; capital equipment requirements and expenditures."

"Costs for surcharges when volume fluctuations adversely affect original plan."

"Costs to service that firm under current approach (all elements of cost), and anticipated costs under various scenarios of a proposed QR Approach."

"Upstream--requirements for information, ability to respond to changing rate of demand.  
Downstream--POS or other accurate forecast data, order size, and turnaround requirements, EDI Transactions."

"What are current inventories and turns. Is the supplier dependable and has he made changes throughout the production/procurement process?"

3a. Do you currently have this information available?  
Please indicate any missing information.

"Yes" (4 responses, no further comments)

Not applicable to firm-retailer

"Partially"

"No. No forward visibility to spikes in demand."

"Yes, or can get at them with a fair degree of accuracy."

"Downstream with Walmart only."

3b. If not available, what would your firm need to do to obtain the information?

"Major effort to identify costs would be required."

"Better modeling of demand curves."

"Vendors/Customers generally need better systems."

4. Your firm has decided to implement a continuous improvement program. What information will you require to implement a continuous improvement process and measure performance in logistics? What cost information would you require to justify changes in your logistics processes?

"Current cost per cubic meter for all aspects of the pipeline."

"Cost per order, cost per pound shipped, labor cost."

"Output per man hour, pounds handled per man hour, order fulfillment rate, all types of inventory measures for stock outs, cube utilization of truckload orders."

"Need a benchmark--either historical or standard, such as costs/unit or cost/dollar."

"Process metrics based on external customer satisfaction, consistently utilized. Focus on only key metrics. Cost would be secondary assuming cycle time was one metric, e.g. less time, less cost."

"Productivity numbers, accuracy and on-time shipping performance, damage and safety information; labor and operating expenses, actual versus budgeted as well as a percentage of sales or costs."

"Establish current cost structure and determine the cost of non-conformance to the prescribed quality standards."

"Need to know and understand current costs and the drivers of those costs; need to know current operations performance against indices; (we measure costs against several indices to help us understand our performance)."

"Regular data collection on a wider variety of logistics activities, and related benchmarks."

"Any logistics cost component on the increase or an opportunity to significantly reduce costs would justify a change."

4a. Do you currently possess the capability to obtain this information?

"Yes" (4 responses, no further comments)

"Yes, via ABC"

"Not in most countries."

"Yes, except cost."

"Not all; difficult to collect from selected functions."

"To some extent; more flexibility is needed."

4b. What changes would you recommend to your firm's senior executives to obtain any required information?

"Performance based information systems versus accounting based, or at least in addition to accounting based."

"None"

"I would like to have management reports in specific formats versus current process of taking accounting data and keying to a spreadsheet."

"System upgrades to minimize measurement administratively and reduce error. Also, better data for root cause analysis."

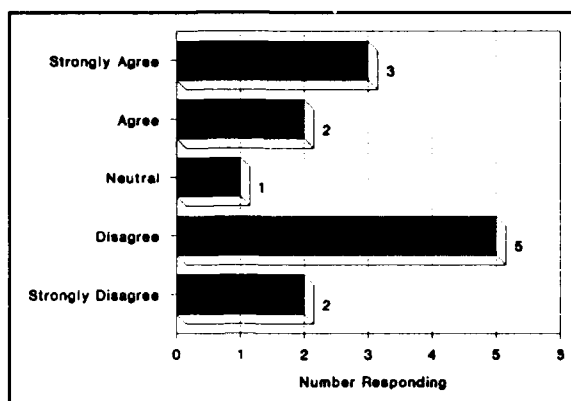
"Uniform and corporate-wide program."

"Invest in systems capable of meeting the diverse needs of customers, and flexible enough to capture the cost in a variety of ways. Rigid systems quickly become a competitive disadvantage."



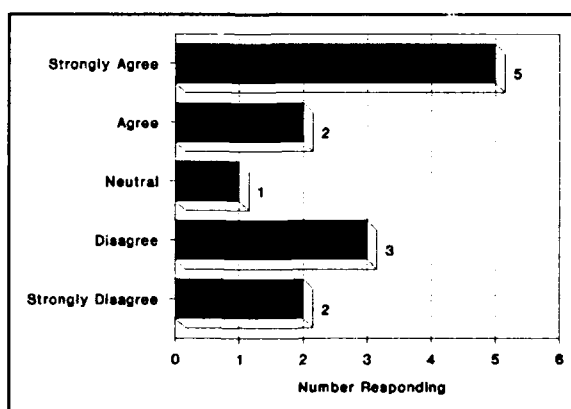
## Part II.

1. Our firm allocates logistics overhead or indirect costs to products, services, or customers on a percentage basis of a single cost driver such as direct labor or product volume.



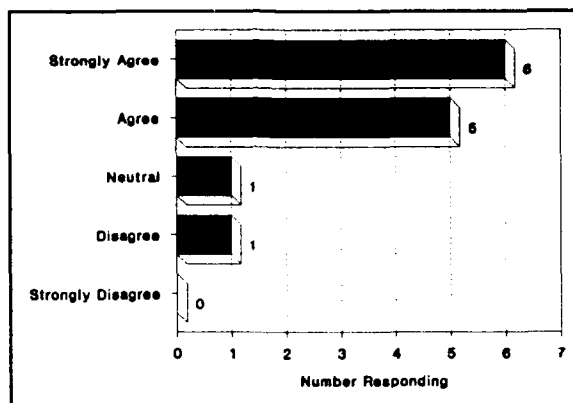
**Figure 30.** Responses to Use Of a Single Cost Driver

2. My company includes other factors such as the type of product or service provided to determine logistics costs.



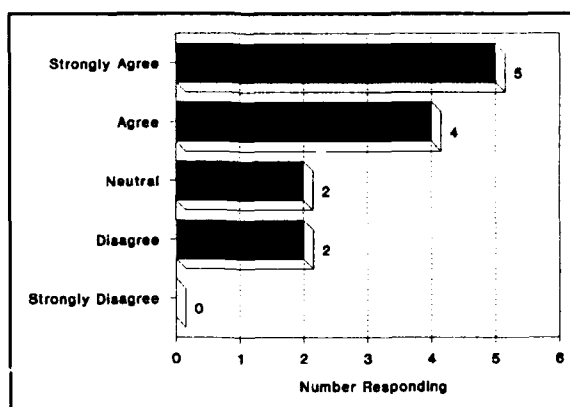
**Figure 31.** Use of Multiple Drivers to Determine Charges

3. My company offers a diverse range of products and logistics services to our customers.



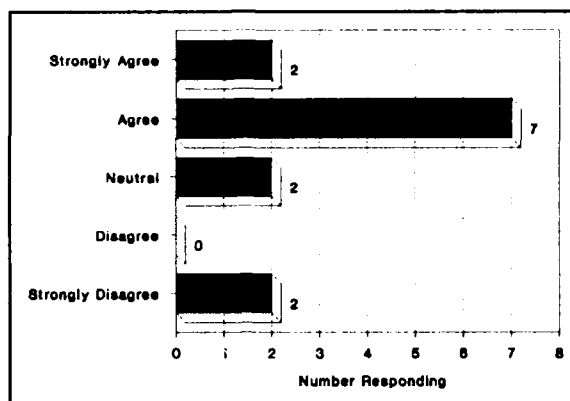
**Figure 32.** Diverse Range of Logistics Service Offerings

4. The products and logistical services produced by our firm consume unequal amounts of logistics support such as packaging, labor, transportation, and information requirements.



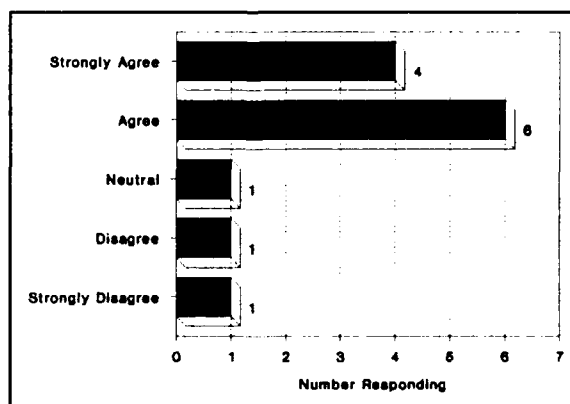
**Figure 33.** Services Consume Unequal Amounts of Support

5. Our company breaks out logistics overhead costs based on actual consumption to major processes such as customer service, warehousing, transportation, and physical distribution.



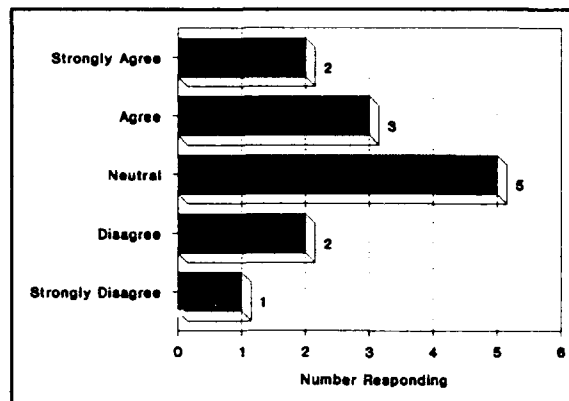
**Figure 34.** Overhead Broken Out by Actual Consumption

6. My firm can further breakout logistics overhead costs to the activity or task level such as order processing, receiving, storage, order picking, shipping, and transporting.



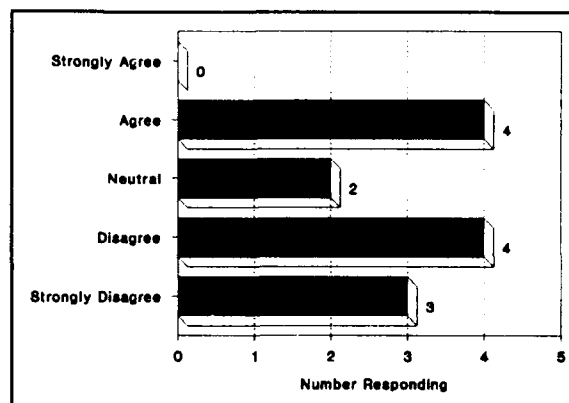
**Figure 35.** Breakout Overhead to the Activity or Task Level

7. My company can accurately determine the amount of general administration, supplies, MIS, and utilities actually consumed by individual logistics activities or tasks.



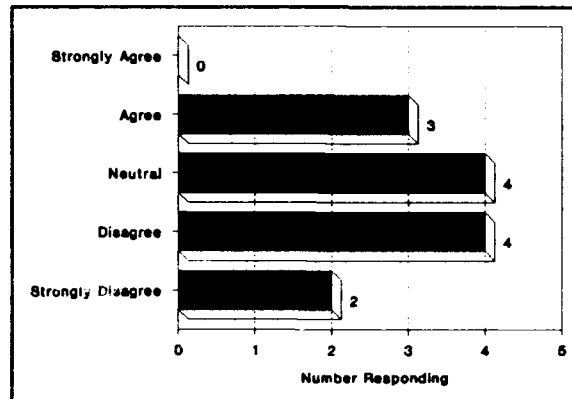
**Figure 36.** Determine Amount of Overhead Consumed by Individual Activities

8. Competitive pricing has forced my firm to revise our logistics charges according to how individual services, products, customers, or distribution channels consume logistical resources.



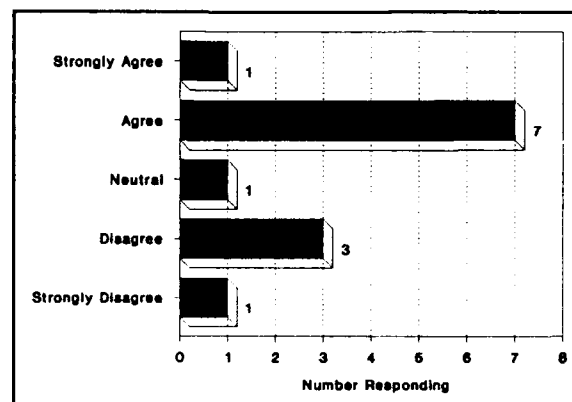
**Figure 37.** Competitive Pricing Has Forced a Revision of Logistics Charges

9. I can use the output from my company's cost accounting system to clearly demonstrate a cause and effect relationship between the work performed and the amount of overhead consumed.



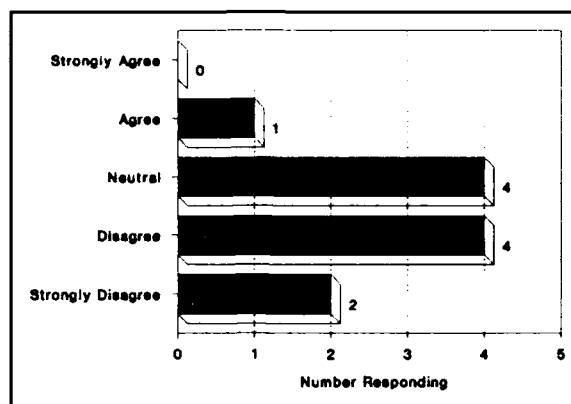
**Figure 38.** Cost Accounting System Can Demonstrate a Cause and Effect Relationship

10. Our company can calculate the costs of loss and damage, returned goods, rewarehousing, or preparing bills of lading by product, customer, or mode of shipment.



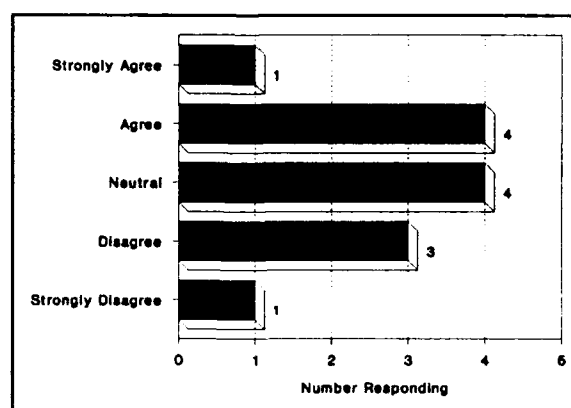
**Figure 39.** Can Cost Specific Activities by Product, Customer, or Mode

11. My firm has obtained a competitive advantage by pricing logistics services according to their actual consumption of material handling, MIS, utilities, and other overhead costs.



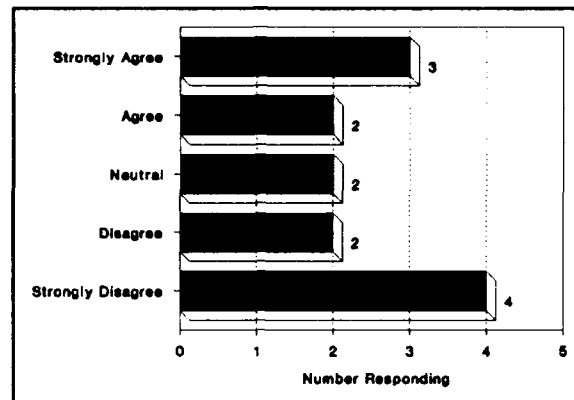
**Figure 40.** Firm Has Obtained A Competitive Advantage Through More Accurate Pricing

12. Our performance measurement system can directly translate productivity improvements at the activity or task level into cost savings within our logistics system.



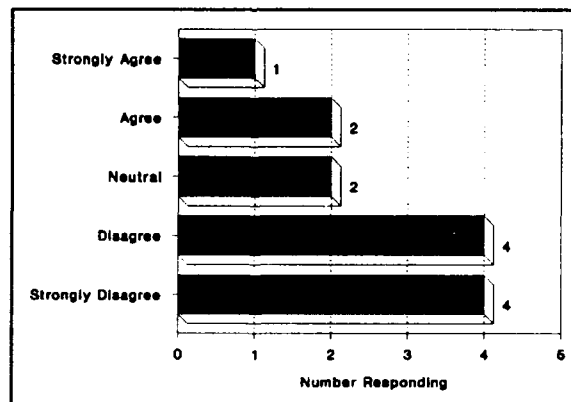
**Figure 41.** Ability to Translate Improvements Into Cost Savings at Activity Level

13. My firm is investigating the use of Activity-Based Costing (ABC) as a method for more closely defining logistics costs.



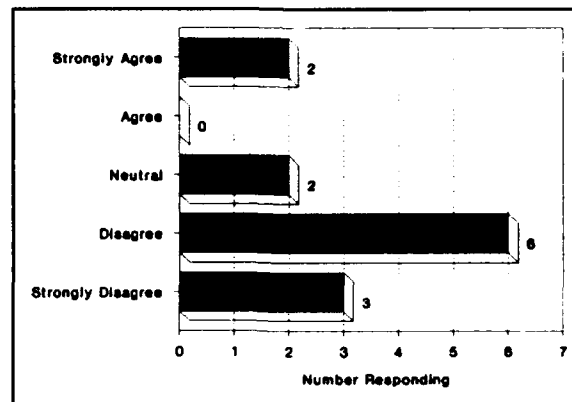
**Figure 42.** Investigating Use of Activity-Based Costing

14. My firm has implemented, or is in the process of implementing, an ABC system.



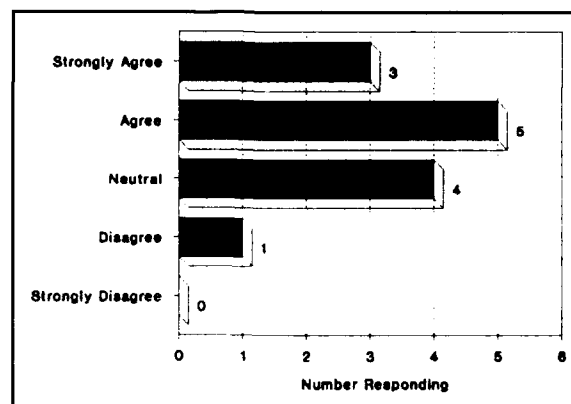
**Figure 43.** Implementing ABC

15. Our firm does not consider the allocation or assignment of overhead or indirect costs as an important element of logistics costing or performance measurement.



**Figure 44.** Allocation of Overhead Not an Important Element of Costing or Performance Measurement

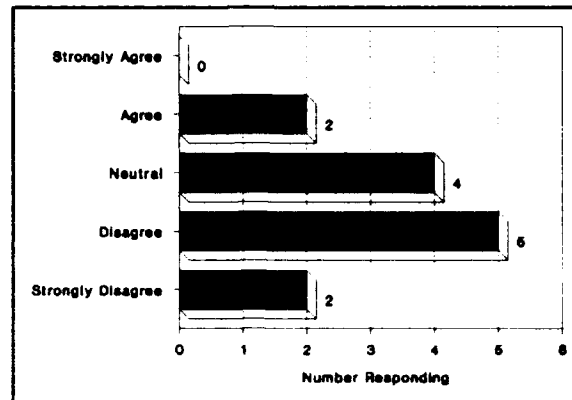
16. My firm intends to evaluate potential vendors based on the total cost of doing business rather than focusing solely on price.



**Figure 45.** Vendor Evaluation Will be Based on Total Cost Rather Than Price

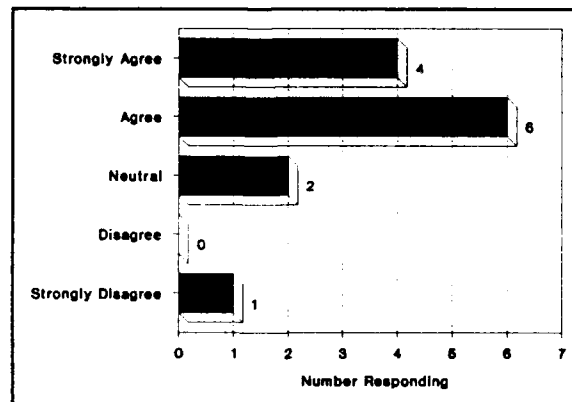


17. Our current cost accounting system possesses the capability to trace and accumulate the total logistics costs of dealing with specific vendors.



**Figure 46.** Current Cost Accounting System Can Trace Costs to Specific Vendors

18. In the future, my company will require the capability to accurately break out direct and indirect logistics costs by type of product, customer, service or logistics activity to remain cost competitive.



**Figure 47.** Will Need to Accurately Break Out Costs To Remain Cost Competitive

APPENDIX H  
PROFILE OF RESEARCHED ORGANIZATIONS

## PROFILE OF RESEARCHED ORGANIZATIONS

ORGANIZATION A. This company is a "small" organization in the food products industry and distributes products on a national basis. The organization is using ABC as a diagnostic tool.

ORGANIZATION B. This company is a "small" organization in the food products industry and distributes products on a national basis. The organization uses ABC on a periodic basis and has implemented ABM.

ORGANIZATION C. This company is a "large" organization in the chemical industry and distributes products to international and domestic customers. The company is using ABC on a periodic basis at several plant locations.

ORGANIZATION D. This company is a "large" organization in the food products industry and distributes products on a national and international basis. The company has used ABC as a diagnostic tool in several subsidiary firms.

ORGANIZATION E. The company is a "small" division of a larger organization in the office supply industry. The division has implemented ABC as a diagnostic tool and has plans for expanding applications within the division.

ORGANIZATION F. The organization is a "large" distribution center of construction materials in support of federal government operations. The distribution center encompasses a wide range of logistical functions ranging from procurement, item management, and financial control. The organization has reached the planning stage of ABC implementation.

ORGANIZATION G. The organization is also a "large" distribution center in support of government organizations but specializes in industrial products. The organization has reached the operational stage of ABC implementation. The ABC system is periodic and used for diagnostics and process reengineering.

ORGANIZATION H. The company is a "large" manufacturer and distributor within the electronics and computer industry. The company has implemented ABC in manufacturing and is exploring applications within logistics.

ORGANIZATION I. The division is a "small" distribution center for a major manufacturer and distributor of computer products and peripheral devices. The company has implemented ABC in several manufacturing and logistics divisions. The ABC systems are rather sophisticated and are used for diagnostics, performance measurement (manufacturing only), and process reengineering.

ORGANIZATION J. The company is a "large" organization in the food products industry with several subsidiary firms. The company uses a sophisticated ABC system primarily for assigning logistics costs to its product divisions.

ORGANIZATION K. The organization is a "small" distribution center for a health and beauty aids manufacturer. The distribution center stores and distributes products in support of national and international customers. The distribution center has a sophisticated ABC system used in support of process reengineering, cost assignment to product divisions, and profitability analysis.

TABLE 18  
CASE STUDY PARTICIPANTS  
INDIVIDUALS CONTACTED

Organization	Individuals Contacted			
	Vice President	Director	Manager	Analyst
Organization A				X
Organization B	X	X	X	
Organization C		X		X
Organization D	X			X
Organization E	X	X	X	X
Organization F		X	X	X
Organization G	X	X	X	X
Organization H	X		X	X
Organization I		X	X	X
Organization J			X	X
Organization K		X	X	X

## BIBLIOGRAPHY

1. A.T. Kearney, Inc., *Improving Quality and Productivity in the Logistics Process—Achieving Customer Satisfaction Breakthroughs*, Oak Brook, IL: Council of Logistics Management, 1991.
2. Aitken, Alan, "How ABC is Cutting Costs in US Companies," *CIMA Management Accounting*, November 1991, pp. 42-59.
3. Alling, Philip C., "Accounting and Control Research," Presentation and Notes, The Council of Logistics Management Doctoral Consortium, October 10, 1992.
4. Alyathurai, Gerald, W.W. Cooper, and P.K. Sinha, "Note on Activity Accounting," *Accounting Horizons*, December 1991, pp. 60-67.
5. Ames, B. Charles and James D. Hlavacek, "Vital Truths About Managing Your Costs," *Harvard Business Review*, January-February 1990, pp. 140-147.
6. Antos, John, "Activity-Based Management for Service, Not-for-Profit, and Governmental Organizations," *Journal of Cost Management*, Vol. 6, No. 2. (Summer 1992), pp. 13-23.
7. Arthur D. Little, Inc. and The Pennsylvania State University, Center for Logistics Research, *Logistics in Service Industries*, Oak Brook, IL: The Council of Logistics Management, 1991.
8. Ballou, Ronald H., *Basic Business Logistics*, 2 ed., Englewood Cliffs, NJ: Prentice-Hall, Inc., 1987.
9. Beaujon, George J. and Vinod R. Singhal, "Understanding the Activity Costs in an Activity Based Cost System," *Journal of Cost Management*, Vol. 4, No. 1, Spring 1990, pp. 51-72.
10. Beheiry, Mohammed F., "New Thoughts on an Old Concept: The Cost of Quality," *CMA Magazine*, June 1991, pp. 24-25.

11. Berlant, Debbie, Reese Browning, and George Foster, "How Hewlett-Packard Gets Numbers It Can Trust," *Harvard Business Review*, January-February 1990, pp. 178-183.
12. Beynon, Roger, "Change Management as a Platform for Activity-Based Management," *Journal of Cost Management*, Vol. 6, No. 2 (Summer 1992), pp. 24-30.
13. Blank, Steven C., *Practical Business Research Methods*, Westport, CT: AVI Publishing Co., 1984.
14. Blaxill, Mark F. and Thomas M. Hout, "The Fallacy of the Overhead Quick Fix," *Harvard Business Review*, July-August 1991, pp. 93-101.
15. Borden, James P., "Review of Literature on Activity-Based Costing," *Journal of Cost Management*, Spring 1990, pp. 5-12.
16. Bradburn, Norman M. and Seymour Sudman, *Improving Interview Method and Questionnaire Design*, San Francisco: Jossey-Bass Publishers, 1979.
17. Brausch, John M., "Selling ABC," *Management Accounting*, February 1992, pp. 42-46.
18. Brimson, James A., *Activity Accounting: An Activity-Based Costing Approach*, New York: John Wiley & Sons, 1991.
19. Brimson, James A., "How Advanced Manufacturing Technologies are Reshaping Cost Management," *Management Accounting*, March 1986, pp. 25-29.
20. Campbell, Robert J., *Competitive Cost-Based Pricing Systems for Modern Manufacturing*, Westport, CT: Quorum Books, 1992.
21. Campi, John P., "It's Not as Easy as ABC," *Journal of Cost Management*, Vol. 6, No. 2 (Summer 1992), pp. 5-11.
22. Carr, Lawrence P. and Christopher D. Ittner, "Measuring the Cost of Ownership," *Journal of Cost Management*, Vol. 6, No. 3 (Fall 1992), pp. 42-51.
23. Chaffman, Beth M., and John Talbott, "Activity-Based Costing in a Service Organization," *CMA Magazine*, December/January 1991, pp. 15-18.
24. Clark, Alex and Alexander Baxter, "ABC + ABM = Action, Let's Get Down to Business," *CIMA Management Accounting*, June 1992, pp. 54-55.

25. Clemens, James D., "How We Changed Our Accounting System," *Management Accounting*, February 1991, pp. 43-46.
26. Colley, J. Ron, Mark A. Segal, and Ara G. Volkan, "The ABCs of Allocating Inventory Cost," *The National Public Accountant*, July 1990, pp. 26-29.
27. Collier, David A., *Service Management*, Unpublished Manuscript, 1991.
28. Cooper, Robin, "ABC: A Need, Not an Option," *Accountancy*, September 1989, pp. 86-88.
29. Cooper, Robin, "Implementing an Activity-Based Cost System," *Journal of Cost Management*, Spring 1990, pp. 33-42.
30. Cooper, Robin, "Five Steps to ABC System Design," *Accountancy*, November 1990, pp. 78-80.
31. Cooper, Robin, "The Rise of Activity-Based Costing--Part One: What Is an Activity-Based Cost System?" *Journal of Cost Management*, Summer 1988, pp. 45-54.
32. Cooper, Robin, "The Rise of Activity-Based Costing--Part Two: When Do I Need an Activity-Based Cost System?" *Journal of Cost Management*, Fall 1988, pp. 41-48.
33. Cooper, Robin, "The Rise of Activity-Based Costing--Part Three: How Many Cost Drivers Do You need, and How Do You Select Them?" *Journal of Cost Management*, Winter 1989, pp. 34-46.
34. Cooper, Robin, "The Rise of Activity-Based Costing--Part Four: What Do Activity-Based Cost Systems Look Like?" *Journal of Cost Management*, Spring 1989, pp. 38-49.
35. Cooper, Robin, "The Two Stage Procedure in Cost Accounting: Part One," *Journal of Cost Management*, Summer 1987, pp. 43-51.
36. Cooper, Robin, "You Need a New Cost System When...", *Harvard Business Review*, January-February 1989, pp. 77-82.
37. Cooper, Robin and Robert S. Kaplan, "Activity-Based Systems: Measuring the Cost of Resource Usage," *Accounting Horizons*, Vol. 6, No. 3, September 1992, pp. 1-13.
38. Cooper, Robin and Robert S. Kaplan, *The Design of Cost Management Systems*, Englewood Cliffs, NJ: Prentice Hall, 1991.



39. Cooper, Robin and Robert S. Kaplan, "How Cost Accounting Distorts Product Costs," *Management Accounting*, Vol 69, No. 10, April 1988, pp. 20-27.
40. Cooper, Robin and Robert S. Kaplan, "Measure Costs Right: Make the Right Decisions," *Harvard Business Review*, September-October 1988, pp. 96-103.
41. Cooper, Robin and Robert S. Kaplan, "Profit Priorities from Activity-Based Costing," *Harvard Business Review*, May-June 1991, pp. 130-135.
42. Cooper, Robin, Robert S. Kaplan, Lawrence S. Maisel, Eileen Morrissey, and Ronald M. Oehm, "From ABC to ABM: Does Activity-Based Management Automatically Follow From an Activity-Based Costing Project?" *Management Accounting*, November 1992, pp. 54-57.
43. Coyle, John J., Edward J. Bardi, and C. John Langley, *The Management of Business Logistics*, 5th ed., St. Paul, MN: West Publishing Company, 1992.
44. D. Appleton Company Inc., *Corporate Information Management: Process Improvement Methodology for DoD Functional Managers*, Fairfax, VA: D. Appleton Company, Inc., 1993.
45. Datar, Srikant and Mahendra Gupta, "Aggregation, Specification, and Measurement Errors in Product Costing," paper presented at the Management Accounting Research Section, American Accounting Association, October 8-10, 1992.
46. Davis, Duane and Robert M. Cosenza, *Business Research for Decision Making*, Boston: Kent Publishing Co., 1985.
47. Davis, Herbert W., "Physical Distribution Costs-1991," *Annual Conference Proceedings of the Council of Logistics Management*, 1991, pp. 357-364.
48. Downs, Cal W., G. Paul Smeyak, and Ernest Martin, *Professional Interviewing*, New York: Harper and Row, 1980.
49. Drury, Colin, "Activity-Based Costing," *Management Accounting CIMA*, Vol. 67, No. 8 (September 1989), pp. 60-66.
50. Dugdale, David, "Costing Systems in Transition," *CIMA Management Accounting*, January 1990, pp. 38-41.
51. Dugdale, David, "The Uses of Activity-Based Costing," *CIMA Management Accounting*, October 1990, pp. 36-38.

52. Eccles, Robert G., "The Performance Measurement Manifesto," *Harvard Business Review*, January-February 1991, pp. 131-137.
53. Eiler, Robert G., and John P. Campi, "Implementing Activity-Based Costing at a Process Company," *Journal of Cost Management*, Vol. 4, No. 1 (Spring 1990), pp. 43-50.
54. Eiler, Robert G., Walter K. Goletz, and Daniel P. Keegan, "Is Your Cost Accounting Up to Date," *Harvard Business Review*, July-August 1982, pp. 133-139.
55. Ernst & Whinney, *Transportation Accounting & Control: Guidelines for Distribution and Financial Management*, Oak Brook, IL: National Council of Physical Distribution Management, 1983.
56. Ernst & Whinney, *Warehouse Accounting and Control: Guidelines for Distribution and Financial Managers*, Oak Brook, IL: National Council of Physical Distribution Management, 1985.
57. Ferrara, William L., "The New Cost/Management Accounting," *Management Accounting*, Vol. 72, No. 4, pp. 48-52.
58. Foster, George and Charles T. Horngren, "Flexible Manufacturing Systems: Cost Management and Cost Accounting Implications," *Journal of Cost Management*, Fall 1988, pp. 16-24.
59. Foster, George and Charles T. Horngren, "Cost Accounting and Cost Management in a JIT Environment," *Journal of Cost Management*, Winter 1988, pp. 4-14.
60. Fowler, Floyd J. Jr., *Survey Research Methods*, Beverly Hills, CA: Sage Publications, 1984.
61. Fox, Roland, "ABC: A Comment on the Logic," *CIMA Management Accounting*, October 1991, pp. 32-35.
62. Fuller, Joseph B., James O'Connor, and Richard Rawlinson, "Tailored Logistics: The Next Advantage," *Harvard Business Review*, Vol. 71, No. 3 (May-June 1993), pp. 87-98.
63. Goldenberg, Charles B., and Donald H. Turner, "Cost of Ownership: As Easy as ABC?" *NAPM Insights*, September 1991, pp. 10-11.

64. Grady, Michael W., "Is Your Cost Management System Meeting Your Needs?" *Journal of Cost Management*, Summer 1988, pp. 11-15.
65. Green, F.B., Felix Amenkhienan, and George Johnson, "Performance Measures and JIT," *Management Accounting*, February 1991, pp. 50-53.
66. Greenwood, Thomas G., and James M. Reeve, "Activity-Based Cost Management for Continuous Improvement: A Process Design Framework," *Journal of Cost Management*, Winter 1992, pp. 22-40.
67. Hardy, John W., and E. Dee Hubbard, "ABC Revisiting the Basics," *CMA Magazine*, November 1992, pp. 24-28.
68. Harr, David J., "How Activity Accounting Works in Government," *Management Accounting*, September 1990, pp. 36-29.
69. Heckert, J. Brooks, *The Analysis and Control of Distribution Costs*, New York: The Ronald Press Company, 1940.
70. Heckert, J. Brooks and Robert B. Miner, *Distribution Costs*, 2nd ed., New York: The Ronald Press Company, 1953.
71. Herr, John D., "Managing Logistics Costs as a Business Investment," *Emerging Practices in Cost Management*, Barry J. Brinker ed., Boston, MA: Warren, Gorham & Lamont, 1990, pp. 219-224.
72. Hiromoto, Toshiro, "Another Hidden Edge--Japanese Management Accounting," *Harvard Business Review*, July-August 1988, pp. 22-26.
73. Horngren, Charles T., and George Foster, *Cost Accounting, A Managerial Emphasis*, 6th ed. (1987), Englewood Cliffs, NJ: Prentice Hall, p. 326 quoted in Brimson, James A., *Activity Accounting*, New York: John Wiley & Sons, Inc., 1991, page 116.
74. Houlihan, John B., "International Supply Chain Management," *International Journal of Physical Distribution and Materials Management*, Vol. 15, No. 1, 1985, pp. 22-38.
75. Howell, Robert A. and Stephen R. Soucy, "Cost Accounting in the New Manufacturing Environment," *Management Accounting*, August 1987, pp. 42-48.

76. Innes, John and Falconer Mitchell, "ABC: A Survey of CIMA Members," *CIMA Management Accounting*, October 1991, pp. 28-30.
77. Innes, John and Falconer Mitchell, "Activity Based Costing Research," *CIMA Management Accounting*, May 1990, pp. 28-29.
78. Jeans, Mike and Michael Morrow, "The Practicalities of Using Activity-Based Costing," *Management Accounting (UK)*, November 1989, pp. 42-44.
79. Johnson, H. Thomas, "Activity Management: Reviewing the Past and Future of Cost Management," *Journal of Cost Management*, Winter 1990, pp. 4-7.
80. Johnson, H. Thomas, "It's Time to Stop Overselling Activity-Based Costing," *Management Accounting*, Vol. 54, No. 3 (September 1992), pp. 26-35.
81. Johnson, H. Thomas, and Robert S. Kaplan, *Relevance Lost*, Boston, MA: McGraw-Hill, 1991.
82. Kaplan, Robert S., "The Four-Stage Model of Cost Systems Design," *Management Accounting*, Vol 71, No. 8, February 1990, pp. 22-26.
83. Kaplan, Robert S., "In Defense of Activity-Based Cost Management," *Management Accounting*, November 1992, pp. 58-63.
84. Kaplan, Robert S., "Must CIM be Justified by Faith Alone?" *Readings and Cases in the Management of New Technology*, H. Noori and R. Radford eds., Englewood Cliffs, NJ: Prentice Hall, 1990.
85. Kaplan, Robert S., "One Cost System Isn't Enough," *Harvard Business Review*, January-February 1988, pp. 61-66.
86. Kaplan, Robert S., "Yesterday's Accounting Undermines Production," *Harvard Business Review*, July-August 1984, pp. 95-101.
87. Kaplan, Robert S., and David P. Norton, "The Balanced Scorecard--Measures That Drive Performance," *Harvard Business Review*, January-February 1992, pp. 71-79.
88. Keegan, Daniel P., Robert G. Eiler, and Joseph V. Anania, "The Factory of the Future," *Management Accounting*, December 1988, pp. 31-37.

89. Kinard, James C., "Conceptual Foundations of Product Costing Systems," paper presented to The Third (1993) Critical Perspectives on Accounting Symposium, American Accounting Association, April 18, 1993.
90. Kress, George J., *The Business Research Process*, Ft. Collins, CO: Kandid Publications, 1974.
91. Kurt Salmon Associates, Inc., *Efficient Consumer Response*, Washington, D.C.: Food Marketing Institute, January, 1993.
92. LaLonde, Bernard J., Martha C. Cooper, and Thomas G. Noordewier, *Customer Service: A Management Perspective*, Oak Brook, IL: The Council of Logistics Management, 1988.
93. LaLonde, Bernard J. and Larry W. Emmelhainz, "Career Patterns of Logistics Executives: 1985," *Proceedings of the Twenty-Third Annual Conference of the Council of Logistics Management*, 1984, pp. 1-20.
94. LaLonde, Bernard J., John R. Grabner, and James F. Robeson, "Integrated Distribution Systems: A Management Perspective," *International Journal of Physical Distribution Management*, October 1970, page 46, quoted in James R. Stock and Douglas M. Lambert, *Strategic Logistics Management*, 2 ed., Homewood, IL: Richard D. Irwin, Inc., 1987, page 27.
95. LaLonde, Bernard J., James M. Masters, and Terrance L. Pohlen, "The 1991 Ohio State University Survey of Career Patterns in Logistics," *Annual Conference Proceedings of the Council of Logistics Management*, 1991, pp. 43-64.
96. Lambert, Douglas M. and John I. Mentzer, "Is Integrated Physical Distribution Management a Reality?" *Journal of Business Logistics*, Vol. 2, No. 1 (1980), pp. 18-27, quoted in Stock, James R. and Douglas M. Lambert, *Strategic Logistics Management*, 2nd ed., Homewood, IL: Richard D. Irwin, Inc., 1987, p. 575.
97. Lamond, Stewart, "Activity-Based Management: An Australian Perspective," *Journal of Cost Management*, Vol. 6, No. 2 (Summer 1992), pp. 42-46.
98. Lancioni, Richard, "Distribution Cost Accounting in International Logistics," *International Journal of Physical Distribution and Logistics Management*, pp. 12-16.
99. Lee, John Y., "Activity-Based Costing at Cal Electronics Circuits," *Management Accounting*, Vol. 72, No. 4, pp. 36-38.

100. Lewis, Richard L. and Leo G. Erickson, "Distribution System Costing: An Overview," *Distribution System Costing: Concepts and Procedures*, (Proceedings of the Fourth Annual James R. Riley Symposium on Business Logistics, ed. John R. Grabner and William S. Sargent; Columbus, Ohio: Transportation and Logistics Research Foundation, The Ohio State University, 1972) pp. 1-30.
101. Lewis, Ronald J., "Activity-Based Costing for Marketing," *Management Accounting*, November 1991, pp. 33-38.
102. Luther, Robert G., "Fixed Costs and Sunk Costs in Decision-Making," *Management Accounting*, Vol. 70, No. 1 (January 1992), page 37.
103. MacArthur, John B., "Activity-Based Costing: How Many Cost Drivers Do You Want?" *Journal of Cost Management*, Vol. 6, No. 3 (Fall 1992), pp. 37-41.
104. MacArthur, John B., "Zero-Base Activity-Based Costing," *Journal of Cost Management*, Vol. 6, No. 4 (Winter 1993), pp. 45-49.
105. McKinsey & Company Inc., *The McKinsey Manual of Direct Product Profit*, The National Association of Food Chains, October, 1964.
106. Martin, Andre J., *DRP: Distribution Resource Planning, Distribution Management's Most Powerful Tool*, 2ed., Oliver Wight Limited Publications, Inc., 1990.
107. Menzano, Ralph J., "Activity-Based Costing for Information Systems," *Journal of Cost Management*, Vol. 5, No. 1 (Spring 1991), pp. 35-39.
108. Miller, Jeffrey G. and Thomas E. Vollman, "The Hidden Factory," *Harvard Business Review*, September-October 1985, pp. 142-150.
109. Miller, John A., "Designing and Implementing a New Cost Management System," *Journal of Cost Management*, Vol. 5, No. 4 (Winter 1992), pp. 41-53.
110. Moravec, Robert D. and Michael S. Yoemans, "Using ABC to Support Business Re-Engineering in the Department of Defense," *Journal of Cost Management*, Vol. 6, No. 2 (Summer 1992), pp. 32-41.
111. Morrow, Michael, and Martin Hazell, "Activity Mapping for Business Process Redesign," *CIMA Management Accounting*, February 1992, pp. 36-38.

112. Nicoll, Andrew D., "Determining Optimum Logistics Costs," *APICS*, February 1992, pp. 50-54.
113. O'Guin, Michael, "Focus the Factory With Activity-Based Costing," *Management Accounting*, Vol. 71, No. 8, February 1990, pp. 36-41.
114. Ostrenga, Michael R., "Activities: The Focal Point of Total Cost Management," *Management Accounting*, Vol. 71, No. 8, February 1990, pp. 42-49.
115. Pendlebury, John and Richard Platford, "The Heavy Hidden Cost of Materials Handling," *Journal of Cost Management*, Vol. 2, No. 1, Spring 1988, pp. 4-8.
116. Pillsbury DPP Share Group, *Practical Applications of Direct Product Profit*, (Undated pamphlet).
117. Piper, J.A. and P. Walley, "Testing ABC Logic," *CIMA Management Accounting*, September 1990, pp. 37-42.
118. Piper, J.A. and P. Walley, "ABC Relevance Not Found," *CIMA Management Accounting*, March 1991, pp. 42-54.
119. Porter, Michael E., *Competitive Advantage Creating and Sustaining Superior Performance*, New York: The Free Press, 1985.
120. Quillian, Lawrence F., "Curing 'Functional Silo Syndrome' With Logistics TCM," *CMA Magazine*, June 1991, pp. 9-14.
121. Raffish, Norm, and Peter B.B. Turney, "Glossary of Activity-Based Management," *Journal of Cost Management*, Vol. 5, No. 3, pp. 53-64.
122. Ray, David, "Distribution Costing: The Current State of the Art," *International Journal of Physical Distribution and Logistics Management*, Vol. 6, No. 2, 1975, pp. 75-107.
123. Roehm, Harper A., Melissa A. Critchfield and Joseph F. Castellano, "Yes, ABC Works With Purchasing," *Journal of Accountancy*, November 1992, pp. 58-62.
124. Rotch, William, "Activity-Based Costing in Service Industries," *Journal of Cost Management*, Summer 1990, pp. 4-14.
125. Roth, Harold P., and A. Faye Borthick, "Getting Closer to Real Product Costs," *Management Accounting*, Vol. 70, No. 11, May 1989, pp. 28-33.

126. Roth, Harold P., and Linda T. Sims, "Costing for Warehousing and Distribution," *Management Accounting*, Vol. 73, No. 2, August 1991, pp. 42-45.
127. Schiff, Michael, *Accounting and Control in Physical Distribution Management*, Oak Brook, IL: National Council of Physical Distribution Management, 1972.
128. Sevin, Charles H., *Marketing Productivity Analysis*, New York: McGraw-Hill, Inc., 1965.
129. Shank, John K. and Vijay Govindarajan, *Strategic Cost Analysis*, Homewood, IL: Irwin, 1989.
130. Shank, John K. and Vijay Govindarajan, "Strategic Cost Management and the Value Chain," *Journal of Cost Management*, Vol. 5, No. 4, Winter 1992, pp. 5-21.
131. Sharman, Paul A., "A Practical Look at Activity-Based Costing," *CMA Magazine*, February 1990, pp. 8-12.
132. Sharman, Paul A., "A Tool Kit for Continuous Improvement," *CMA Magazine*, May 1992, pp. 17-21.
133. Sharman, Paul A., "Activity-Based Costing: A Practitioner's Update," *CMA Magazine*, July-August 1991, pp. 22-25.
134. Skousen, K. Fred, Harold Q. Langenderfer, and W. Steve Albrecht, *Principles of Accounting*, New York: Worth Publishers, Inc., 1981.
135. Stalk, George Jr., and Thomas M. Hout, *Competing Against Time*, New York: The Free Press, 1990.
136. Steimer, Thomas E., "Activity-Based Accounting for Total Quality," *Management Accounting*, Vol. 72, No. 4, pp. 39-42.
137. Stock, James R. and Douglas M. Lambert, *Strategic Logistics Management*, 2 ed., Homewood, IL: Richard D. Irwin, Inc., 1987.
138. Strauss, Anselm and Juliet Corbin, *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, New York: Sage Publications, 1990.
139. Thilmony, Hal, "Product Costing: One Set of Books or Two?" *Journal of Cost Management*, Vol. 6, No. 4 (Winter 1993), pp. 37-44.



140. Troxel, Richard B., and Milan G. Weber, Jr., "The Evolution of Activity-Based Costing," *Journal of Cost Management*, Vol. 4, No. 1 (Spring 1990), pp. 14-22.
141. Turney, Peter B.B., "Activity-Based Management," *Management Accounting*, January 1992, pp. 20-25.
142. Turney, Peter B.B., *Common Cents: The ABC Performance Breakthrough*, Hillsboro, Oregon: Cost Technology, 1991.
143. Turney, Peter B.B., "How Activity-Based Costing Helps Reduce Cost," *Journal of Cost Management*, Vol. 4, No. 4, Winter 1991, pp. 29-35.
144. Turney, Peter B.B., "Using Activity-Based Costing to Achieve Manufacturing Excellence," *Journal of Cost Management*, Summer 1989, pp. 23-31.
145. Turney, Peter B.B. and Alan J. Stratton, "Using ABC to Support Continuous Improvement," *Management Accounting*, Vol. 54, No. 3 (September 1992), pp. 46-50.
146. Tyndal, Gene R., "Analyzing the Costs and Value of the Product Distribution Chain," *Journal of Cost Management*, Spring 1988, pp. 45-51.
147. Tyndal, Gene R., "Just-in-Time Logistics: Added Value for Manufacturing Cost Management," *Journal of Cost Management*, Spring 1989, pp. 54-59.
148. Tyndal, Gene R., "Logistics Cost Management: Analyzing the Costs and Value of the Product Distribution Chain," *Journal of Cost Management*, Vol. 2, No. 1, Spring 1988, pp. 45-51.
149. Tyndal, Gene R., "Logistics Costs and Service Levels," *Emerging Practices in Cost Management*, Barry J. Brinker ed, Boston, MA: Warren, Gorham, & Lamont, 1990, pp. 211-217.
150. Tyndal, Gene R., "Obtaining Better Information to Control Freight Costs: Some Guidelines," *Journal of Cost Management*, Summer 1988, pp. 55-61.
151. Tyndal, Gene R., and John R. Busher, "Improving the Management of Distribution with Cost and Financial Information," *Journal of Business Logistics*, Vol. 6, No. 2, pp. 1-18.

152. Upgras, Y. Joseph, "Factors Affecting Allocation of Noncontrollable Costs for Performance Evaluation Use: A Survey," paper presented at the Management Accounting Section Research Conference, American Accounting Association, October 8-12, 1992.
153. Van Creveld, Martin, *Supplying War: Logistics From Wallenstein to Patton*, Cambridge, England: Cambridge University Press, 1977.
154. Vollmers, Gloria and Horace Givens, "Distribution Costs and the Dennison Manufacturing Company: 1920-1950," Paper presented at the Northeast American Association of Accounting Conference, April, 1993.
155. Walker, Mike, "ABC Using Product Attributes," *CIMA Management Accounting*, October 1991, pp. 34-35.
156. Wayman, Wilbur S., "Harnessing the Corporate Accounting System for Physical Distribution Cost Information," *Distribution System Costing: Concepts and Procedures*, (Proceedings of the Fourth Annual James R. Riley Symposium on Business Logistics, ed. John R. Grabner and William S. Sargent; Columbus, Ohio: Transportation and Logistics Research Foundation, The Ohio State University, 1972) pp. 31-45.
157. Weisman, Dennis L., "How Cost Allocation Systems Can Lead Managers Astray," *Journal of Cost Management*, Vol. 5, No. 1 (Spring 1991), pp. 4-10.
158. Woods, Michael D., "Completing the Picture: Economic Choices with ABC," *Management Accounting*, Vol. 64, No. 6 (December 1992), pp. 53-57.
159. Yakhou, Mehenna and Boubekour Rahali, "Integration of Business Functions: Activity and Life Cycle Accounting," *APICS-The Performance Advantage*, January 1993, pp. 36-37.
160. Zikmund, William G., *Business Research Methods*, 3rd ed., Chicago: The Dryden Press, 1991.